ERRATA

PART TWO, CHAPTER XXXIX, SPECIAL SUBJECTS REGIONAL
(Volume 1)

✓ Pg. I-44, Par. 146, Line 13; change 150,000 to 1,500,000.

NEW ENGLAND-NEW YORK INTER-AGENCY COMMITTEE
150 CAUSEWAY STREET
BOSTON 14, MASSACHUSETTS

Final revisions
Special Subjects Regional
Chapter XXXIX Part Two
Volume 1
March 21, 1955

1. Attached are revised pages xv, xvi, xvii, xviii, xix, xx, xxi, xxii, xxiii, xxiv, xxv, xxvi, xxvii, xxviii, xxix, xxx, xxxi, xxxii, xxxiii, xxxiv, xxxv, xxxvi, xxxvii, xxxviii, xxxix, and four additional photographs, - comprising the final revision for Part Two Chapter XXXIX of the Report of the New England-New York Inter-Agency Committee entitled The Resources of the New England-New York Region, Special Subjects Regional, Volume 1. Note that each revised page is identified by the revision symbol in the lower corner. It is requested that you open the binding of your copy, remove the superseded pages, insert the revised pages, and destroy the replaced pages.

2. The four additional photographs are to be inserted as indicated on revised page XXXVII, List of Photographs.

3. Also attached is an errata sheet showing minor corrections for which no revised pages are furnished. It is requested that you make all the changes indicated on the errata sheet.

4. Upon completion of the above, the copy of the Chapter of the Report you have will be in final form.

G. B. Troland

G. B. TROLAND
Coordinator

FOREWORD

This book contains Volume 1 of 4 volumes comprising Chapter XXXIX of Part Two of the Report of the New England-New York Inter-Agency Committee, organized by direction of the President of the United States for the purpose of making a comprehensive survey of the land, water and related resources of the New England-New York Region.

The complete report comprises three parts:

Part One - The General Report.

Part Two - The Technical Report, with detailed studies of the river basins and special subjects.

Part Three - Reference Data.

NOTE

Chapter XXXIX, Special Subjects, Regional, is published in four volumes:

Volume 1. Fisheries, Wetlands.

Volume 2. Mapping, Mineral Commodities.

Volume 3. Mineral Commodities.

Volume 4. Hurricanes.

THE RESOURCES

OF THE

NEW ENGLAND-NEW YORK REGION

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THE RESOURCES

OF THE

NEW ENGLAND-NEW YORK REGION

PART TWO

CHAPTER XXXIX

SPECIAL SUBJECTS
REGIONAL

VOLUME 1
(of 4 volumes)

NEW ENGLAND - NEW YORK INTER-AGENCY COMMITTEE

SPECIAL SUBJECTS, REGIONAL

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SECTION I - COMMERCIAL OFFSHORE FINFISHERIES OF NEW ENGLAND

INTRODUCTION

1. This section presents a discussion of the extent and value of the offshore fisheries of New England; the fishery management and development practices in operation; and the measures designed to maintain the offshore fishery resources and the fish industry.

2. The offshore fisheries are considered to include only those species of fish which are taken on a commercial basis.

3. The New England commercial finfisheries are an important part of the total United States and Alaska commercial fish and shellfish catch which, in 1951, ranked fourth in the total world catch. Japan, China, and the U.S.S.R., in that order, were the chief producers of all types of fish, crustaceans and mollusks.

4. On a national basis in 1951, California led the States in quantity and value of fish and crustaceans landed. Massachusetts ranked second and Alaska third. In this listing, the remaining New England States fared as follows: Maine - seventh in quantity and eighth in

value; Rhode Island - seventeenth in quantity and eighteenth in value; Connecticut - twenty-seventh in both quantity and value; New Hampshire - thirty-fifth in quantity and thirty-first in value.

5. On a percentage basis, the New England States contributed about twenty-one percent of the total U. S. and Alaska catch and about nineteen percent of the value.

6. The commercial fishing industry of New England is one of the few large industries in the area which is situated in proximity to its base of raw supplies, the productive fishing banks of the northwest Atlantic Ocean. Although New England is generally considered to be lacking in natural resources, the northwest Atlantic comprises one of the world's most valuable fishing areas.

7. There are many facets to the complete story in dealing with the offshore fisheries of New England. As this section can only deal with the natural resource per se, it does not begin, or even attempt to touch on all of the problems and needs of the industry based on that resource.

8. Fishing is the oldest industry in New England. The colonists depended on the huge and readily available supply of fish for a major part of their livelihood. As living conditions bettered, they succeeded in exporting fish to the home country and elsewhere. The development of the fabulous New England whaling industry was an outgrowth of these early days, as was the start of the New England manufacturing industry. The need for ships, supplies and goods to be traded led to the development of ship chandlers, which in turn developed into the brass and other metal-working industries. The sugar, hides, gold and silver taken in payment for fish stimulated sugar refining, shoemaking, and jewelry production.

9. To meet the demand for trade goods, new industries arose. Textile manufacturing is an example which was largely started on capital derived from fishing and trade. As these industries expanded and became less dependent on the fishery, the relative position changed. Fishing became a secondary occupation and lost its once preeminent position.

10. The introduction of the otter trawl in catching fish, and filleting in the processing of fish which began in the 1920's revolutionized the fishing industry but did not enable it to regain its former favored position. In recent years, the improvement in vessels and techniques for finding, catching and processing fish has greatly lessened the dangers and risk connected with the commercial fishery. However, many and varied problems beset all phases of the industry. An apparent decline in abundance of the principal fish species is of vital concern. Whether the decline is due to overfishing or to a change in migratory habits is yet to be established.

NEW ENGLAND OFFSHORE FISHING GROUNDS

11. The fishing grounds available to the New England commercial fisherman are characterized by a wide continental shelf, extending about 1,000 miles from Long Island to Newfoundland, and containing about 260,000 square miles. Large areas of the shelf rise to form plateaus, called banks, on which are found a vast population of bottom-living fishes called groundfish. Plate 1 shows the locations and areas of the major fishing Banks.

12. Tides and currents are violent in this area, but the pattern of the latter is favorable to keeping the drifting eggs and larvae of groundfishes on the banks in areas conducive to survival. Extreme temperatures vary from near freezing in winter to over 68 degrees in summer, but in the most favorable parts of the New England Banks, they range from about 38 to 55 degrees. The banks are composed mainly of mud, sand, and gravel and form an almost perfect habitat for groundfish.

13. The pelagic and shore fishes are not so dependent on the ocean bottom but are dependent, and hence available to the fishing industry, on a free-floating food supply. Pollution, obstruction of rivers by dams, and siltation of spawning beds are depressing factors on the numbers of certain fish species.

COMMERCIAL FINFISH SPECIES, HARVEST, AND VALUE

14. About 80 species of edible finfish inhabit the waters available to New England commercial fishermen. Of these, over 56 species made up the catch in 1952, but the catch of only 37 species totalled more than 100,000 pounds each during that year. Table 1 shows the total pounds landed and landed value of these fishes in 1952 for New England.

Table 1 - Total New England catch and value of commercial finfisheries - 1952.

Species 1/	Pounds	Value
Alewives	5,930,300	$ 69,584
Bluefish	139,000	27,747
Butterfish	4,635,700	401,439
Cod	42,401,100	2,994,087
Cusk	3,699,700	194,984
Eels: Common	101,800	18,577
Gray Sole	5,748,400	564,694
Lemon Sole	3,170,700	564,180
Yellowtail	16,744,900	1,947,216
Blackback	14,851,300	1,986,647
Dab	7,606,500	678,170
Fluke	6,860,700	1,308,431
Haddock	161,341,000	12,491,726
Hake: Red	3,956,800	72,799
Hake: White	11,783,800	554,441
Halibut	395,700	103,454
Herring	153,513,000	1,873,697
Mackerel	12,525,100	954,660
Menhaden	36,087,900	443,235
Minnows	116,900	8,403
Ocean Perch	189,042,000	8,210,065
Ocean Pout	404,000	6,089
Pollock	26,953,100	995,752
Scup	6,807,400	391,860
Sea Bass	860,700	70,126
Shad	578,000	70,051
Sharks	156,300	8,515
Skates	137,400	4,313
Smelt	177,900	41,721
Striped Bass	161,100	39,003
Swordfish	301,700	112,361
Tautog	130,200	6,412
Thimble-Eyed Mackerel	115,000	2,309
Tilefish	1,649,100	157,281
Tuna, Bluefin	1,145,900	142,960
Whiting	105,954,700	2,217,457
Wolffish	2,009,800	135,664
Trash fish	53,012,200	457,798
Totals:	881,206,800	$ 40,327,908

1/ Species included are those whose catch totalled 100,000 pounds or more in 1952.

Table 2 - Total catch and value of the commercial finfishery in New England.

	Pounds	Value
1940	576,092,500	$ 14,196,477
1941	No data	
1942	659,591,000	27,527,000
1943	598,949,000	32,544,000
1944	669,706,000	31,858,000
1945	845,470,600	56,589,042
1946	744,651,000	41,551,000
1947	738,871,000	35,618,000
1948	939,334,000	46,344,000
1949	931,432,000	38,577,000
1950	941,706,000	39,281,000
1951	850,095,000	45,117,000
1952	892,752,600	41,120,188

15. In addition, the 19 fish species not listed totalled 367,700 pounds, and $17,382 in value. Table 2 reflects the total catch and value of commercial finfishery in New England during the years 1940 to 1952.

16. The finfishes are generally grouped according to the habits of the species. The three main groups of marine fishes are the groundfish, shore fishes and pelagic fishes. The following discussion describes these groups and outlines the habits and habitat and gives the data on the catch and value for each species for each of the New England States.

GROUNDFISH

17. Groundfish is the term applied to many kinds of fishes that live on or near the bottom. Taken together, they are the most important marine resource of New England and the third most productive and valuable in the United States. North Atlantic groundfish can live only in the food-rich, cool water on the continental shelf. Usually, they are confined to depths shallower than 100 to 150 fathoms. Beyond these contours the bottom deepens rapidly to one or two miles and the water becomes too warm, barren, or otherwise unsuitable for them. These fish are taken mainly by otter trawls, huge conical nets that are dragged close to the ocean floor.

OCEAN PERCH

18. The ocean perch or rosefish supports a fishery that has grown spectacularly in recent years. In 1933, when only 264,000 pounds were caught, it ranked one hundred and thirtieth in volume of production among the United States fisheries. In 1952, over 189 million pounds were caught, which ranked it first in volume among New England fishes. This remarkable growth came as a result of the utilization of ocean perch by the filleting industry.

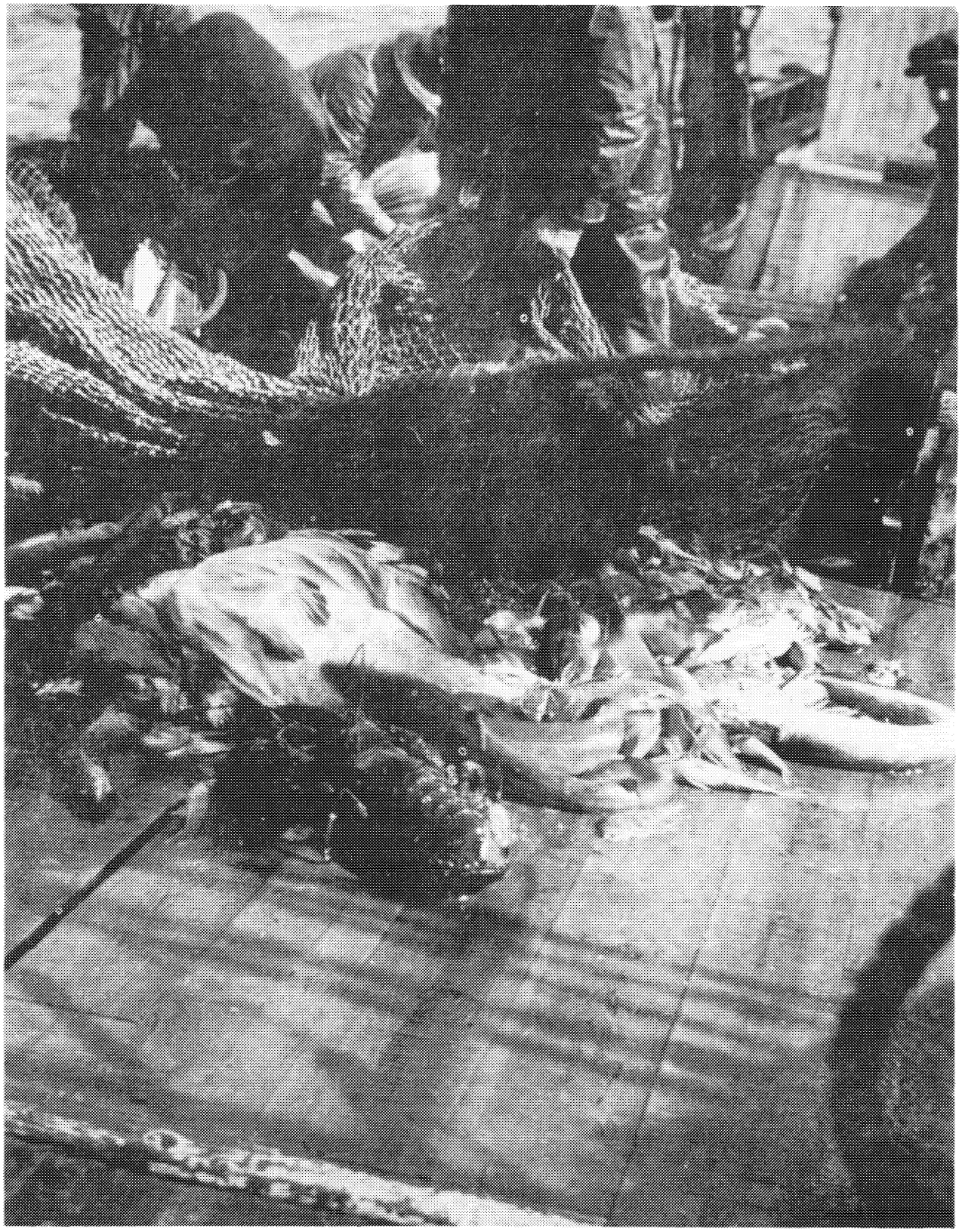
19. Practically the entire catch is taken by otter trawls in depths of 50 to 125 fathoms. Fishing is carried on throughout the year, but only during daylight hours as a general rule, for the fish scatter or rise off the bottom at night.

20. Ocean perch is one of the few commercial species giving birth to live young instead of spawning eggs. The young are discharged from June until September and are abundant at or near the surface throughout the summer. The fish grow slowly at a rate of about an inch a year, until around their eleventh year, when they mature. Little is known about their migrations, but there is some evidence that the larger fish move about over considerable distances so that an intensive fishery on one ground will affect the ocean perch populations on others.

21. The rapid expansion of the ocean perch fleet and catch has resulted in a considerable decline in the yield from the nearby grounds as the accumulated stocks of older fish were caught. In order to supply the market, the fleet has expanded operations to progressively more distant grounds and is concentrating to an increasingly greater extent on small fish.

HADDOCK

22. The haddock of the Northwest Atlantic make up a complex of populations of which at least three main groups are recognized, inhabiting respectively the New England Banks, the Nova Scotian Banks, and the Newfoundland Banks. The fish vary between groups as to growth rate, spawning time, migratory habits, fluctuations in size of stock, and other biological features. Knowledge about these populations is growing



Dragger operations. Typical haul of miscellaneous fish. New England-New York Region.

but is still incomplete. Over 95 percent of the catch of haddock is by otter trawls, the remainder mostly by line trawls. Small amounts are also taken with anchored gill nets. Most of the haddock is sold as fresh or frozen fillets, some as cleaned fresh fish.

23. Haddock spawn for the first time when three or four years old and two to three pounds in weight. The spawning schools gather during February to April or later in favorable areas on the Banks, usually where the water is from 30 to 60 fathoms deep. The eggs are spawned into the surrounding water, are fertilized there, and drift passively in the currents while they incubate. They hatch in two to four weeks, and the larvae, and subsequently the young fish, continue to drift for two to three months before beginning their bottom existence. If adverse currents carry the drifting young to areas where the water is too deep or conditions are otherwise unsuitable, the young perish. The most important nursery grounds in the New England Banks are on southeast Georges Bank at 50 to 60 fathom depth. Haddocks' migrations during their first year are very limited but increase as they grow older and larger.

24. The haddock populations on the New England and Nova Scotian Banks are to a great extent independent of each other, for there is no considerable exchange between these banks of haddock eggs or of young haddock, either during their drifting stages or during the first years of their life on the bottom. Occasional and limited migrations between these banks have been observed for older fish.

25. In New England, the earliest records on the haddock catch started in 1887 and totaled about 40 million pounds. The catch reached a peak in 1930 when 264 million pounds were landed. Since that time, the catch has declined, and in recent years has averaged about 150 million pounds.

COD

26. The cod resource, perhaps the largest of the North American Banks, yields a billion pounds of fish a year to fishermen of the United States, Canada, and Newfoundland. In the last century, when salting was the only economical way of preserving fish for widespread distribution, the cod supported the largest fishery of the United States because the species is particularly well suited to preservation by this method. The development of refrigeration and of the filleting industry, however, brought the haddock into prominence in the 1920's, since haddock were more plentiful on the nearby grounds and more suitable for filleting than cod; and because the demand for salt fish was declining in this country, cod became less sought after by United States fishermen. Recently, the annual catch in New England has been around 50 million pounds.

27. The biggest part of the United States catch of cod is taken with otter trawls; the balance with lines, sink gill nets, floating traps, and pound nets. Most cod are marketed as fresh and frozen fillets and steaks, and a small quantity is salted and smoked. Other products are pickled cod tongues and canned fish flakes. The skins from the salted fish are made into a high quality glue. Liver oil made from the livers of haddock, cod, hake, pollock, etc., is one of the principal sources of Vitamin D. It also has a number of industrial uses.

28. Cod live in much the same depths and on the same type of bottom as haddock, but whereas the latter is the dominant species (in bulk at least) on Georges Bank, cod become increasingly dominant off Nova Scotia and exceed any other bottom fish on the Newfoundland Banks and beyond. Cod spawn over a wide area from the New England Banks eastward. The heaviest concentrations on the New England coast are found on eastern Georges Bank, in the same localities as haddock, but somewhat earlier in the season.

29. The greatest number of yearling cod have been found on southeast Georges Bank in somewhat deeper water than the older fish. On Georges Bank, young cod grow to about $7\frac{1}{2}$ inches in their first year, and reach 15 to 16 inches at two years of age. Growth on the Nova Scotian Banks, which are farther north, is slower than on Georges Bank. Cod grow to enormous size, the largest recorded specimen measuring over six feet long and weighing 211 pounds. However, the commercial catch is made up principally of fish weighing $2\frac{1}{2}$ to 25 pounds.

30. It is not known to what extent the cod populations found in the Gulf of Maine, on Georges Bank, and on the Eastern Banks are independent, but these fish are known to move about more than haddock. The catch per day's fishing has varied widely over the past 10 years. It is not known whether these variations reflect changes in the population, migrations, or a shifting of the primary objective of the fishery between haddock and cod. An understanding of measures needed to obtain maximum utilization of this resource must await a basic study of the cod populations and the conditions which govern their yield.

FLOUNDERS

31. The flounder resource of the North Atlantic yields about 60 million pounds a year and ranks about fourth in volume in the New England catch. Until recent years, it was hardly touched, for the small mouths of many of the species saved them from the hooks of line trawls and no considerable market existed for some of the more abundant species. In 1900, for example, only 4.5 million pounds were landed. The introduction of the otter trawl and development of the filleting industry stimulated growth of the flounder fishery. Today, about 97 percent of the catch is taken with otter trawls, the balance chiefly with line trawls. A small amount of flounder is smoked; and some flounder roe is canned.

32. Flounders and their flatfish allies are a unique group of fishes. A newly hatched flounder swims erect like any other fish and has eyes on both sides of its head. As the young fish develops, however, one eye migrates around the head to a location next to the other eye and the fish begins to swim on its side. The body becomes much flattened, the eyed side develops color, the blind side remains white. Nearly all members of the same species are twisted in the same direction; hence, flounders are designated as right-handed or left-handed, depending on which side possesses the eye and color.

33. All species of flounders are carnivorous, but most possess such small mouths that their diet must consist solely of small, bottom-living, invertebrate animals such as shrimps, mollusks, starfish, and worms. They spawn from midwinter to midsummer, but mostly in the spring.

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YELLOWTAIL

34. Yellowtail is the most important of the North Atlantic flounders. Prior to about 1935, it was considered a trashfish and was landed in small quantities at very low prices. With the decline of the blackback fishery, the small otter trawlers turned to yellowtail fishing and the public learned of the excellent table qualities of this species. This led to the development of a flounder fillet industry at New Bedford and the expansion of the yellowtail fishery. In 1952, the New England landings of yellowtails were about 17 million pounds, surpassing those of all other flatfishes.

35. Since 1942, this fishery has yielded progressively smaller catches, although the intensity of fishing and the demand for yellowtail have increased. Unfortunately, sufficient knowledge is lacking concerning this resource to prescribe intelligent conservation measures for the fishery. Preliminary data on the biology, commercial catch, and abundance are being obtained. Much additional information is required on stocks, natural mortality, rate of growth, and effect of fishing on the stock.

36. Yellowtail are found in 10 to 50 fathoms of water. Like most flounders, they spawn in the late spring, mostly during May and June, along the southern New England coast. The eggs drift a short time with the currents and the young fish descend to the bottom when about half an inch long. Yellowtails mature when 10 to 12 inches long and about three years old. The adults subsist mostly on small invertebrate animals such as shrimps, mollusks, worms, starfish, etc.

37. Tagging experiments have shown that yellowtail migrate seasonally. The appearance and disappearance of yellowtail schools and changes in the sex ratio and size composition indicate rather complex movements yet to be studied.

BLACKBACK

38. The blackback or winter flounder is the second most important of the North Atlantic flounder. The catch of this species has declined steadily to less than 20 million pounds. This change can be attributed to a decline in the size of the blackback population and to a shift of portions of the fleet to the newly developed yellowtail fishery.

39. Blackback spawn in the winter and spring in depths of 1 to 3 fathoms. The eggs sink to the bottom and stick together in small clusters. The fish grow rapidly and become sexually mature at 8 to 10 inches and 3 to 4 years of age. The fish are relatively nonmigratory, moving only to cooler waters outside the bays in summer and back to inside waters in winter.

40. The rapid growth rate helps the blackback to persist under the intensive fishery. The nonmigratory habit, however, means that conservation measures must be more or less localized to fit local units of the blackback populations. To obtain better utilization of the existing supply of this resource, a minimum size limit of 10 inches has been recommended for certain waters of Long Island, New York. Allowing the fish to grow before catching them will in itself increase fishermen's tonnages and also increase the number of spawning adults.

LEMON SOLE

41. Lemon sole, or Georges Bank flounder, is a fish closely related to the winter flounder; indeed, it is probably only a race of blackback flounder rather than a distinct species, though this is a matter of dispute. In any event, the trade uses the name lemon sole for individuals of both kinds which weigh over $2\frac{1}{2}$ or 3 pounds. This size limit varies among dealers and among cities. About a half million pounds sold under this name are caught annually. True lemon sole seem to be limited in their distribution to Georges Bank.

GRAY SOLE

42. Gray sole is one of the deeper water flounders found principally on soft, muddy, and clay bottoms in 25 to 120 fathoms of water. About a half million pounds are caught annually, most of it by the large otter trawlers incidentally with their catches of haddock and cod.

43. It is marketed almost entirely as fillet of sole. Practically nothing is known about this resource on which to base an opinion as to the possibility of increasing production.

SEA DAB

44. Sea dab is a deep-water flounder taken mostly on sandy bottoms in 15 to 60 fathoms by large otter trawlers as an incidental catch while fishing for cod and haddock. About a half million pounds are landed annually. It is mostly filleted and marketed as fillet of sole. Virtually nothing is known of the biology of this fish, or the production possibilities.

HALIBUT

45. The North Atlantic halibut resource was fairly important 50 to 60 years ago, when it yielded around 13 million pounds annually. At present, hardly more than 400,000 pounds are landed each year. This is the result of reduced stocks caused by intensive fishing.

46. Some halibut are taken incidentally by otter trawlers fishing for groundfish but a greater part of the catch has been taken by a few line trawlers which specialize in halibut fishing on the edge of the continental shelf off the Nova Scotian banks in 100 to 200 fathoms of water.

47. Atlantic halibut is marketed almost entirely as fresh and frozen fish. Some is smoked and put up in 5-ounce glass tumblers. Salted halibut was marketed on a fairly extensive scale at Gloucester in the 19th century but is rarely prepared today since the abandonment of the halibut fishery on the Grand Banks off Newfoundland.

48. The halibut is the largest of our flat fishes. Present-day specimens run from 20 to 200 pounds, but in former years individuals of over 700 pounds were taken. These huge fish are exceedingly voracious and their diet consists of various kinds of market and other fishes. If halibut are ever to be restored to the New England waters in anything like the numbers present in Colonial days, it seems inevitable that a sizeable share of the cod, haddock, whiting, and hake which now support important fisheries will be required to feed them.

POLLOCK

49. The pollock, often called Boston bluefish, has increased in importance in recent years. Just before the second World War, about 38 million pounds

were caught annually, about 67 percent of it with otter trawls, about 25 percent of it with anchored gill nets, the rest with purse seines, lines, floating traps, and pound nets. At present, the annual catch totals about 25 million pounds.

50. Pollock is prepared as fresh and frozen fillets, is salted, and a small amount is smoked. It makes a good dry salt fish, though the color is not as white as dried cod. In the last few years, some pollock has been canned commercially as fish flakes.

51. Important as the species is to the United States fishing industry, little is known about its biology, or extent of the resource in American waters.

52. Pollock spawn off the mouth of Massachusetts Bay from October through February. The egg is buoyant and is slightly less than one-twentieth of an inch in diameter; it hatches in six to nine days, depending on temperature, and the larvae are less than one-fifth of an inch long. The young drift near the surface for several months, then gradually settle to the bottom. In the Bay of Fundy, pollock average five to six inches by the second spring, and about 12 inches by the third spring. By the fourth summer, that is at $3\frac{1}{2}$ years of age, the fish are from 14 to $18\frac{1}{2}$ inches long. The growth rate in the Gulf of Maine and along the Massachusetts coast is not known.

CUSK

53. The cusk is a member of the cod family and is taken in deep waters of more than 60 fathoms, the catch usually being incidental to cod fishing. Unlike most other bottom fishes, it does not school but

is of solitary habit. The cusk is more important in European fisheries than it is likely to become on this side of the Atlantic, where it has never been abundant.

54. New England fishermen in 1952 took nearly 4 million pounds of cusk. Most of the catch is made during the winter and spring, with small quantities landed at other seasons. Approximately 50 percent of the catch is made with line trawls; the balance with anchored gill nets, otter trawls, and hand lines.

55. Although the cusk may grow to a length of three feet and a weight of 30 pounds, the commercial catch consists mostly of fish 1½ to 2 feet in length, averaging five pounds or so in weight.

56. The cusk is marketed largely as fresh and frozen sticks and fillets. Some cusk fillets are smoked and sold as "finnan haddie." Until World War I, almost the entire catch was salted; a small amount is still preserved in this way.

57. Very little is known about the biology of the cusk on the New England coast, and practically nothing about the size and extent of the cusk populations and potential catch.

WHITING

58. Whiting or silver hake are taken commercially from Sable Island to South Carolina. In the Gulf of Maine, they are a summer fish, appearing first in the Cape Ann-Massachusetts Bay region in March and becoming increasingly abundant as the waters warm. Off Long Island, they are common throughout most of the year, being taken offshore by otter trawlers from November through March, and inshore by pound netters

from April through July. Off North Carolina, they are caught in the winter trawl fishery. They are also caught with floating traps, anchored gill nets, and even in purse seines. Otter trawlers, particularly of the Gloucester, Boston, and Provincetown fleets, have taken increasing amounts of whiting, and the catch has consequently risen from 14 million pounds in 1930 to 105 million pounds in 1952.

59. The bulk of the catch is cleaned and skinned, then frozen and packaged; it is sold as pan-dressed, split, or filleted whiting. It is popular in the Middle West, especially Kansas City, where it is used in fried fish sandwiches. Before the second World War, some whiting and waste from filleting and skinning were canned for pet food.

60. Nothing is known regarding the extent of the population, the rate of growth, or the size at maturity of whiting, nor are more than fragmentary data available regarding nursery grounds. Whiting spawn from June through September. The eggs and, subsequently, the larvae drift in the currents. The young fish descend to bottom probably when 1 to 1½ inches long. Whiting are found on sandy and pebbly bottoms from the shoreline to a depth of about 300 fathoms. Fishermen report that this fish is becoming smaller and more scarce, with former highly productive grounds now barely furnishing a day's fishing. However, there are no scientific records of the abundance of this fish.

HAKE

61. Hake is a name applied to several species of closely related fishes found from Newfoundland to Cape Hatteras. Two of these are taken commercially: the white hake, or whiting, which until very recently

made up almost the entire catch, and the red hake, which had remained unutilized until wartime shortages created an unusual demand for fish in 1943 and 1944. Something over 12 million pounds of hake are now caught annually, close to 66 percent of it with line trawls, and most of the balance with otter trawls and anchored gill nets. Hake is sold fresh, frozen, salted, dried, and as smoked fillets. The air bladders are dried and used for making isinglass; the livers are collected for vitamin oils.

62. White hake grows to 20 to 30 pounds, but the average-sized fish landed is five pounds or less. Red hake average a pound to two, and though of good flavor, are so soft-bodied that preservation is difficult. Very little is known of the biology of hakes or about the extent to which the supply is being utilized. The fishery for both of these species could probably be expanded if the market warranted. The so-called "trash fishery" takes many millions of pounds of these species, but they are not specifically identified other than as trash fish.

TILEFISH

63. The tilefish is one of the most interesting, from a biological point of view, of the commercial fish species. One of the latest fish to be found and described, in 1879, the tilefish is only found along the outer edge of the continental shelf and on the upper slope abreast of the east coast of the United States. Here, where the inner edge of the Gulf Stream maintains constant temperature of 47 to 50 degrees, the tilefish ranges in depths of 50 to 200 fathoms.

64. The dependence of the tilefish on these conditions in a very limited range led to almost complete destruction of the species in 1882.

The catastrophe was best explained as a sudden flooding of the warm zone by abnormally cold water which completely changed the character of the habitat.

65. The tilefish did not become of importance to the commercial fishery until 1917 when over 11 million pounds were landed. At the present time, about one and a half million pounds are taken each year.

66. The average size of the tilefish is about 4-18 pounds, although fish up to 50 pounds have been reported.

WOLFFISH

67. The wolffish, as the name suggests, is armed with a set of teeth only slightly less formidable than those of the shark. It is a rather large fish, up to five feet in length and about 30 pounds in weight. The body is deepest just behind the head and tapers back to a small, weak tail. Little is known concerning its life history.

68. Although the wolffish is a solitary fish, it is distributed generally on offshore New England Banks and is taken regularly by otter trawlers fishing for haddock, cod or flounders.

69. Although repellent in appearance, the wolffish is an excellent table fish selling readily as "catfish" or "ocean whitefish." In recent years, the New England catch has averaged about 2 million pounds.

SHOREFISH

70. The shore fishes of the New England area comprise a natural resource of about 60 species, including exclusively marine fish as well as those that enter fresh water to spawn. Although only a few shorefishes are of commercial importance, many others are popular with the salt-water anglers. Much of the shorefish resource is composed of migratory populations of fish that move from offshore southern wintering grounds to northern inshore grounds in summer.

SCUP

71. Scup or porgies are caught in the summer in the inshore waters of New Jersey, New York, and southern New England, and during winter in the offshore waters from the Jersey Capes southward to Cape Hatteras. The annual catch of the New England commercial fisheries in recent years has been about 6 million pounds, of which a little over half is normally taken in the winter trawl fishery. About 75 percent of the catch is made with otter trawls, the remainder with pound nets, floating traps, and purse seines. The winter fishery is carried on solely with otter trawls.

72. Sport-fishing activities for this species are concentrated during the summer along the New Jersey beaches and the inshore and bay regions of southern New England.

73. Scup spawn in the inshore waters and bays of New Jersey, Long Island, and southern New England from May to August, but chiefly in June. The same coastal areas serve as nursery grounds. Scup reach an average length of about 4 inches at the end of the first summer, and by the fifth year have attained an average length of 10 inches and an average weight of three-fourths of a pound. The maximum length reported is 18 inches.

Most of the commercial catch consists of fish ranging from three-fourths to one and one-half pounds. Scup move northward and toward shore in the spring, southward and offshore in fall.

74. The yield of scup fluctuates widely. During the past 20 years, the trend of the catch, especially in New Jersey and New York, has been generally upwards, as a result of (1) several years of unusually successful spawning; (2) increase in the number of otter trawlers and other types of vessels; (3) improvements of fishing gear and development of the balloon net.

75. For adequate conservation of this species, it must yet be determined at what fishing intensity the resource will produce the highest sustained yield. Because the catch of scup is so unstable, it is highly desirable to improve methods of handling, freezing, and storing, so that in periods of abundance, surpluses can be properly cared for with a minimum of waste.

BUTTERFISH

76. The butterfish is exclusively a commercial species which supports an annual catch averaging about 4 million pounds in New England. Butterfish spawn in June and July in the bays, sounds, and other inshore waters from Chesapeake Bay to southern New England. By the end of the summer, the young are about four inches long. Market sizes range from 8 to 11 inches and from a quarter of a pound to a pound. Like most other shorefishes, butterfish have fluctuated sharply in abundance during the past 15 years.

77. To sustain the productivity of this resource, and to reduce unnecessary waste, it is necessary to minimize the destruction of immature fish. An effective releasing device for returning captured small butterfish back into the sea has been developed for the pound net and floating-trap fisheries. This device is used in some localities and should be adopted universally among those fishing for this species.

SUMMER FLOUNDER

78. The summer flounder or fluke resource yields about 3 million pounds of commercially caught fish annually and, in addition, supports an extensive sport fishery in the bays and inshore waters of southern New England. This is the only flounder taken in large quantities in the winter trawl fishery off the Virginia Capes and New Jersey. Summer fisheries for this species are carried on chiefly along the southern shore of Long Island and on the coasts of New Jersey and Delaware.

79. The populations of summer flounder available to the winter fishery in the offshore area from the vicinity of New York to Cape Hatteras are believed to be a mixture of fish that summer at various points along the coast. Some tagging has been done in an effort to trace the seasonal migrations of these fish. Most of the larger fish appear to spend the summer in northern regions--northern New Jersey, southern Long Island, and southern New England--while the smaller fish tend to be distributed from southern New Jersey to the Virginia Capes. Flounders that have reached a length of 12 inches or more appear to have a tendency to return year after year to the same summer areas where they were tagged and released.

80. Information on the spawning of fluke is meager. It is believed that the fish spawn in the late fall or early winter, when they are moving offshore or have reached the offshore winter area. In the early spring and summer, more young fish (less than one year old) are found in the inshore waters of Virginia, including the lower region of Chesapeake Bay, than in more northern coastal areas. From this, it is assumed that the southern range of the species may be the most productive spawning and nursery region, from which migrations take place in later years to northern fishing grounds. Tagging experiments recently begun should be continued to test the accuracy of this assumption.

81. Because of its habits and the efficiency of the gear used in its capture, the summer flounder may be in danger of being overfished. Continued observations of the resource are needed so that excessive withdrawals from the stock may be detected quickly and proper steps taken to avoid commercial depletion of the supply. Adoption by the various States of a minimum-size limit, drawn with a view to biological and market considerations, may afford a degree of protection and improve the utilization of the supply.

SHAD

82. Shad are a great American delicacy and among the most famous of our table fishes. They spend part of the year in the ocean and enter fresh water in the spring, spawning in the various rivers of the area. Once they were among the most abundant fish along the coast, and 50 years ago the commercial production of shad was surpassed only by that of cod. Now, in contrast, the catch ranks twenty-first among the fisheries of New England.

83. The history of the shad resource has been one of bad management: The colonists who came to America in the 17th and 18th centuries found the shad in such abundance that they thought the runs were inexhaustible. With great nets, some nearly a mile long, they caught more shad migrating up river to spawn than they needed for food, sold them for as little as a dollar a wagonload to fertilize fields. By the middle of the 19th century, severe depletion of the runs was reported in all the principal fishing areas.

84. The earliest record of a total annual catch of shad from the various runs is for 1880, when over a million pounds of shad were taken. The catch remained high until 1919, then dropped off until 1944-47, when the catch averaged about a million and a half pounds. Since then, the average catch has been around 500,000 pounds.

85. Although the early phases of the decline of the shad fishery are not documented by records of annual production, the later phases, after 1896, are clearly shown by published statistics of the decreasing annual catches. Since there is a separate race of shad indigenous to each river, the rate of decline differs somewhat from river to river, but there are features of similarity in the declines of many runs.

86. The main causes for the decline were the erection of dams and pollution. Dams erected across the rivers on or below the spawning grounds have sharply reduced natural reproduction. Shad have usually failed to ascend fish ladders installed for them in existing dams. It is possible, however, that suitable ladders may be eventually designed that will reopen spawning grounds long denied to this species

by various dams. Pollution only became an important factor with the industrialization of sections adjacent to shad streams. Pollution is detrimental to shad in several ways. It reduces the dissolved oxygen content of the water and introduces toxic substances especially harmful to the young. The flesh of the adult fish takes on an unpleasant oily flavor from polluted water which reduces their market value.

ALEWIVES

87. Alewives, or river herring, members of the herring family, enter the coastal rivers of eastern United States in the spring and return to the ocean after spawning. During their short sojourn in the streams, they support one of the principal river fisheries of the Atlantic coast with an annual yield of nearly 30 million pounds. The most important fisheries for alewives are in the Chesapeake Bay area, the South Atlantic States, and New England, in the order named. In New England, the annual catch is about 5 million pounds.

88. The canning of alewives and their roe is the chief seafood-canning industry of the Atlantic coast from Maryland to North Carolina. Only a small amount of the catch is eaten fresh, much of it is salted, another and possibly larger share is cured in salt and vinegar for use in making such special herring products as bismarck herring and rollmops. Some alewives are smoked. By-products are dry scrap for fertilizer, oil, and pearl essence from the scales.

89. The alewife fisheries are supported by two species with overlapping ranges, the "true" alewife or branch herring found from Nova Scotia and the Gulf of St. Lawrence to the Carolinas, and the blueback,

found from the Bay of Fundy to Florida. Fishermen usually do not distinguish between the species. In general, however, the branch herring predominates in the catch in the North Atlantic area; the blueback in the Chesapeake Bay and South Atlantic States.

90. The spawning runs of alewives begin in March in Chesapeake Bay and in March and April in New England. The fish usually arrive in tremendous numbers, move upstream to the spawning grounds, and return to the sea almost immediately after spawning. The young hatch in two to six days, depending on the temperature, develop rapidly, and in the summer and fall descend to salt water as 2- to 4-inch fish.

91. In New England, alewives are caught chiefly with dip nets during the spawning migration. Pools are constructed about the mouths and in the lower part of the streams, and the fish are led into them by nets and stone diversions and are then easily captured. In Chesapeake Bay, most of the catch is taken by pound nets.

92. The alewife is another example of a resource which has declined sharply through mismanagement. Although depletion has occurred in all areas, it has been most severe in New England, and the causes there are better understood. These are lack of fishways to pass the fish over dams, poorly designed fishways, and excessive fishing. Massachusetts is the only State to have a number of well designed and highly efficient fishways for alewives.

93. In New England, the size of the alewife runs is limited chiefly by the extent of the lake area available for spawning the young, the largest runs all originating from lakes of fair size. In order to make

certain that adequate numbers of adult alewives reach the spawning areas in lakes, a proportion of the adults must be allowed to escape the commercial fishery. All obstructions must be equipped with adequate fishways, providing for the safe passage of both upstream and downstream migrants, and fishways should be inspected periodically to guarantee proper function. To carry out this program, it will be necessary to determine, by careful experiment, the number of spawning fish required in each stream to maintain the maximum runs. Runs may be established in streams where they are now lacking, by planting spawning adults.

TAUTOG

94. The tautog, or blackfish, ranges along the Atlantic coast from the Bay of Fundy to South Carolina, and is most abundant between Cape Cod and the Delaware Capes. Although the tautog is a year-round resident of southern New England waters, it is taken only during the warm months. During the winter, the tautog retire into deeper water lying in the mud or in crevices of rocks usually in a torpid state. Fluctuations in the supply of this fish parallel the character of the winters, for great numbers are killed by unusually severe winter weather.

95. The tautog is found about steep, rocky shores and ledges or over boulder-strewn bottoms, usually in shallow waters up to three or four fathoms in depth. Shellfish and other invertebrates which live in these regions form the chief food supply.

96. The tautog spawns chiefly in June in southern New England waters and by the end of the first year, the young are three to six inches long. The average size is about three pounds, with fish over 10 pounds being rare.

97. Tautog are taken chiefly by lines, traps, or pots, and are marketed as fresh fish, being in great demand due to the fine flavor. The commercial catch totals about 130,000 pounds, but this is a fraction of the total taken by sport fishermen.

SEA BASS

98. Although the sea bass is most common in the Middle Atlantic States, close to 900,000 pounds were taken by New England commercial fishermen in 1952. In addition, many thousands of pounds are taken by sport fishermen. Like the tautog, the sea bass is a fish of the rocky bottoms of southern New England and, in general, the habits of the two species are similar. The average size is about a pound and a half.

COMMON EEL

99. The common eel is found in large numbers all along the east coast and in tributary fresh water streams and lakes. Its life history is just the reverse of the anadromous fish such as shad, salmon and alewife, in that its spawning grounds are in the ocean, but the species spends most of its life in inland waters.

100. About 100,000 pounds are taken annually in New England, usually by nets, eel pots, or spears. The greater part of the catch is used for bait.

OCEAN POUT

101. Ocean pout is very abundant locally, both inshore and on the outer banks. Ordinarily very small quantities of this species are landed, but wartime demands stimulated the landing of four million pounds by otter trawlers in 1943 and 1944. Most of this quantity was

taken from February to May close to New Bedford and Provincetown, Massachusetts, and a large part of it was filleted.

STRIPED BASS

102. The striped bass is a fish of the inshore waters and coastal rivers, seldom being found offshore more than a mile or two, and at times it ascends streams for several hundred miles. Its principal spawning and nursery area along the Atlantic coast has been understood to be in Chesapeake Bay, which is the source of most of the striped bass taken elsewhere along the coast. The fish spawns also in the upper part of Delaware Bay and in the lower Hudson River. The spawning season is in the spring or early summer, the exact time varying with latitude and temperature. Females usually spawn for the first time when four or five years old and about 16 inches long; males often mature at two years (approximately 12 inches).

103. Part of the stock spawned in Chesapeake Bay (probably no more than 10 percent of it) migrates to northern coastal regions. However, this migrating segment of the population may represent 90 percent or more of the supply available to fishermen in northern coastal States. The other 10 percent probably originates from less productive spawning areas in northern States.

104. Striped bass migrate extensively in the spring and fall. In the spring they move from wintering areas in Chesapeake Bay, Delaware Bay, Hudson River, and other coastal rivers and small bays in New Jersey, Long Island, and even southern New England, to more northerly sections of the coast, especially to New England. In the

fall, beginning about September, a return migration occurs, in the course of which "pods" of bass break off from the main run and winter at various spots along the coast from southern New England to New Jersey. The main part of the run appears to continue south to Chesapeake Bay.

105. Striped bass grow rather rapidly. They attain a length of 4 to 5 inches and a weight of about one ounce by the end of the first year. Thereafter, they increase in weight rapidly; at 2 years, the weight is one-half pound; at 4 years, 2¼ pounds; at 8 years, 12 pounds. Fish weighing 40 pounds or more are often caught by commercial fishermen and sometimes by sport fishermen.

106. Because the striped bass supports a large and growing recreational fishery, a conflict was inevitable between the commercial and sports fishermen. The dispute was resolved in favor of the sports fishermen in Connecticut and Massachusetts in 1951, when both States passed legislation prohibiting netting. Rhode Island sportsmen are endeavoring to have a similar law passed.

107. Although the stock of striped bass fluctuates widely, reflecting variations in the survival of the young, unbiased authorities report that the stock will support both sport and commercial fishing. In recent years, the commercial catch in New England of around 200,000 pounds has only been a fraction of the sport catch. Most of the catch is taken in pound and gill nets which are set for other species. In Rhode Island, haul and

purse seines are used when schools of bass are located. The striped bass is sold mainly in the fresh fish markets; small quantities are frozen or otherwise processed.

PELAGIC FISH

108. Pelagic fish are free-swimming fishes of the open sea, not dependent on certain restricted habitats or localities. These fish follow the seasons, or, more correctly, follow their food which is abundant or scarce depending on the season.

109. With the exception of the swordfish and marlins, most commercial pelagic fish are found in huge schools which appear and disappear with dramatic suddenness. Commercial fishing for these species is either a feast or a famine, quite commonly the latter.

MENHADEN

110. The menhaden, in a sense, is the Atlantic counterpart of the Pacific sardine. It is a member of the herring family, and its population in Atlantic waters is large. Unlike the Pacific sardine, the menhaden is used almost exclusively in the manufacture of meal and oil; only small quantities are canned.

111. The menhaden fishery started in New England, eventually spread southward, and is now centered in the Middle Atlantic States, especially in Chesapeake Bay. The annual catch in New England has decreased from 173 million pounds in 1889 to 5,000 pounds in 1930. Most recently, it has increased to 36 million pounds, in 1952. The purse seine is the most important gear used for catching menhaden; pound nets are also used, but are much less important.

112. The meal manufactured from menhaden was formerly used for fertilizer and the oil only for industrial purposes, but research resulted in improvement of both products so that they may now be used in animal and poultry feeds. Menhaden roe is occasionally removed and prepared as a frozen, salted, or canned product.

113. At least three species of menhaden inhabit the Atlantic coast; all are utilized without differentiation by the fishery. They are pelagic, migratory fish, which characteristically travel in schools. Their seasonal migrations control the operations of the fishery. In the spring, large schools appear in coastal waters and even in the brackish waters of the bays, sounds, and larger rivers, where conditions are favorable for their feeding and growth. The young fish, about an inch long upon their arrival, attain an average size during the first year of 5 to 6 inches and a weight of 1 to 1.5 ounces. During the second year, they grow to a length of 8 to 10 inches, weigh approximately seven ounces, and yield variable quantities of oil, depending on latitude (more oil northward than southward) and on variable oceanographic conditions. They are believed to mature during the third or fourth year. They increase in oil content, therefore in value, with age and size.

114. The mature fish are captured chiefly in the fall during their southward migrations to unknown ocean spawning grounds, where they remain until the following spring. Their food consists almost wholly of microscopic plants, chiefly diatoms, and small crustaceans, which swarm at the surface of the sea. These, the menhaden strains from the water that passes through its sievelike gill structures.

Fishing for menhaden. New England-New York Region.

115. Little is known about the biology of this fish. In view of the increased intensity of fishing and expansion of the fishery, more complete information is needed concerning the biology of menhaden, including (1) the routes followed by the three different species and various "races" of menhaden in their annual migrations; (2) the location of the ocean spawning and nursery areas; (3) the parasite which is said to cause sterilization of male menhaden; (4) the food of menhaden and its relation to growth, oil content and availability; (5) the relation of the oceanic climate and of the fishing intensity to production and survival of the young and to maintenance of an adequate brood stock.

HERRING

116. The herring, one of the most important food fishes in the world, ranges on both sides of the North Atlantic Ocean. It is most abundant and intensively fished along the coast of Maine and the Provinces of Nova Scotia and New Brunswick; the United States fishery extends from New Jersey to Maine.

117. About 150 million pounds of Atlantic herring are caught yearly by New England fishermen in recent years and additional large quantities are imported from Canada. Most of the catch is taken with weirs and stop seines, the rest with purse seines, floating traps, and dip nets.

118. The Atlantic herring has been studied in Europe by biologists more than any other fishery resource in the world. In America it has been neglected in this respect, and our knowledge of this fish is meager. Canadian investigators have carried on some research, but the fundamental facts needed for maintaining the highest production of herring in North

America have yet to be developed. There is still little or no knowledge about age, spawning seasons and localities, migrations, "races", fluctuations in abundance, and the causes thereof, and about the effect of the fishery on the size of the stock.

119. Between the Gulf of Maine and Block Island, herring spawn in summer and fall along the shore. The eggs are adhesive, sink to the bottom, and stick to whatever objects they encounter. They incubate for several weeks, longer in colder water than in warmer. The growth rate of the young in New England waters is not known; but in the Bay of Fundy they reach about five inches in length when one year old, and 10 inches when three years old.

120. Schools of small herring occur along the inshore areas from spring to fall, usually disappearing during the winter. The appearance of these schools is erratic, both in time and place. Occasionally one inshore section of the coast may swarm with herring, while another nearby area may be barren of them. There is yet no knowledge to explain or predict such fluctuations.

121. In general, the herring in Maine is subject to an intensive fishery during its first few years of life, but normally is not caught in large numbers after it reaches over 10 inches in length, for only the smaller sizes are demanded by the canneries.

122. The productivity of the United States North Atlantic sardine or herring industry is rarely limited by the available supply of fish. Occasionally, fish are scarce as in 1938 when the Maine herring catch was only 16 million pounds, but ordinarily the production of any year is more or less an index of the demand for the canned product. During years when

the fish are very abundant, the sardine pack does not increase accordingly; however, when a scarcity of fish appears, the pack is necessarily small. In normal times, the industry operates considerably below capacity. The domestic market for canned Maine sardines is limited, since this pack must compete with the high quality product of other countries where the costs of labor and materials are lower than ours.

MACKEREL

123. The Atlantic mackerel fishery in recent years has averaged about 15 million pounds annually. This resource is characterized by peculiarly great fluctuations in abundance, which seriously affect the fortunes of mackerel industries. In the five years 1887-90, the catch averaged 15 million pounds a year; in 1929-48, it was 50 million pounds. Since 1949, it is back to around 15 million pounds. Mackerel are caught mostly with purse seines; also with pound nets, gill nets, and floating traps.

124. Mackerel spawn from Cape Hatteras to the southern part of the Gulf of St. Lawrence, the principal spawning areas being located between Chesapeake Bay and Cape Cod Bay. The average female produces 500,000 eggs. The eggs drift in the water for four to ten days while they incubate; and the young pass through the larval stage and grow to be a third of an inch long in about 40 days, two inches long in about three months.

125. Studies on the spawning grounds have shown infant mortality to be very high. For example, in 1932, it was estimated that of every million eggs spawned, only four young fish survived the first three months. That was apparently a year of unusually high mortality, owing either to an abnormal scarcity of feed or to unfavorable winds which drifted the young

away from grounds favorable to survival. The fish grow rapidly, and spawn for the first time when two years old and 12 to 16 inches long. 126. They first appear in March and April off Chesapeake Bay, and progressively later off the middle Atlantic and southern New England coast. In late June and July they travel around Cape Cod into the Gulf of Maine and also appear off western Nova Scotia. In September, the return migration begins and mackerel reappear south of Cape Cod, where a few may be taken through December and January.

127. Violent year-to-year variations in the catch are at least partly the result of wide variation in the size of annual broods. This variation is further increased by the fact that there are two types of year broods, one of which makes an important contribution to the fishery for many years while the other soon disappears. Fluctuations in catch are also caused by variation in habits of the fish, resulting from changing environment. For example, in 1937, even though scientific evidence indicated a large supply of mackerel in the North Atlantic, fishermen could not locate them, and the catch was the lowest in many years. That summer was noted for its warm, calm weather which resulted in unusually high surface temperatures along the New England coast. These conditions may so have affected the mackerel's distribution and movements that the fish could not be located and captured by the usual forms of gear.

128. Variations in the availability of mackerel make this fishery an unusually great gamble, even for the traditionally uncertain fishing industry. The fisherman must gamble when he outfits for spring, and the dealer must gamble in developing and maintaining an adequate market

geared to the supply. Consequently, it is hard to handle at good prices any great increase in the catch. This appears to be the chief factor in recent years limiting the size of the fleet. **There is still too little knowledge of this resource by which to set a course of action that will materially increase the total mackerel population or reduce the magnitude of the annual variations.**

129. Where it is impossible to control natural phenomena affecting man's well-being, sometimes anticipation of the magnitude and range of their occurrence will be of value. A foreknowledge of the size and availability of the mackerel runs during the approaching summer would assist the fisherman in making his decision concerning conversion to mackerel fishing and would enable the dealer to anticipate his requirements and potential supplies of fish.

130. Attempts have been made to utilize the results of the mackerel studies to predict the coming year's catch. In normal years, the predictions were realized with a fair degree of accuracy, but unusual conditions which developed in 1937 and to a lesser extent in 1939 caused the catches to drop far below the predicted amounts. If the cause of these deviations can be determined, it may be possible to develop a predicting service of material assistance to the mackerel industry.

THIMBLE-EYED MACKEREL

131. The thimble-eyed mackerel is so closely related to the common mackerel that differences are important only to fishery biologists. The two species differ in size, however. The thimble-eyed mackerel grows to a length of about 8 to 14 inches only. For many years, due to the similarities in habit, the two species were not separated in the commercial catch.

132. The thimble-eye is a more southerly ranging fish than the common mackerel, only appearing north of Cape Cod during years of peak abundance. Although the 1952 commercial catch listed 115,000 pounds of this fish, it was not reported in 1949, 1950 or 1951.

SMELT

133. The smelt is one of the few pelagic fish that are most common in northern New England. In 1952, 177,000 pounds were taken in Maine and New Hampshire and only 900 pounds were reported from Rhode Island.

134. The smelt is a small fish rarely reaching 12 inches in length. The spring spawning run begins in New England when the water reaches the required temperature and may occur in February in Connecticut or May in Maine. Spawning takes place only a short distance above tidewater. Adult smelts return to the sea immediately after spawning and spend the summer either in the estuary of the spawning stream or in the sea close by. In October, the smelt gather in harbors and brackish water to spend the winter. At this time, they provide a good sport fishery in addition to the main commercial catch.

135. In the late 1800's, the catch of smelt in New England generally ran over one million pounds a year. The catch declined to about 500,000 pounds a year until 1943-45, when million-pound catches were again made. Since 1949, the catch has been very low, averaging about 150,000 pounds.

BLUEFISH

136. Bluefish is a pelagic species of widespread distribution in different parts of the world. It is excellent as food and is a favorite

game fish. The commercial catch in New England in 1950-52 averaged 130,000 pounds. Commercial fishermen catch bluefish chiefly with traps or pound nets, and with haul seines, gill nets, trammel nets, and with hand and troll lines. Sport fishermen take bluefish chiefly by trolling or surf-casting with artificial lures. The quantity taken by anglers has never been determined accurately, but is estimated to equal or perhaps exceed the commercial catch.

137. The biology and life habits of the bluefish have not been studied in detail in this country, and our knowledge is only that obtained by occasional and incidental observations. Bluefish travel in dense schools. They are extremely voracious, feeding on all kinds of small fishes. They are migratory, but their movements are very erratic and are probably controlled by hydrographic conditions. In general, they move northward in spring and southward in autumn. They are taken in the winter in southern Florida, then off the Carolinas in March and April, off New Jersey in April and May, and off southern New England from early summer to mid-fall. By November, they are taken again in the Carolinas. About the end of November, they appear on the east coast of Florida, and by December on the Gulf Coast.

138. Bluefish are believed to spawn in May or June, probably offshore. Young bluefish of the year's spawning come inshore in late May or June. Growth during the first summer and autumn is rapid. The young fish tend to school according to size. There is no knowledge on which to base an opinion on the size of the population of bluefish, but this much is known: the available supply and probably the actual abundance as well fluctuate greatly.

139. Bluefish are usually sold fresh, although a small amount is frozen. Some quantities of frozen bluefish have been imported from Argentina recently, and there are reports of bluefish off other parts of the South American coast, where plans are being made to freeze these fish for the United States market. Anglers in the United States occasionally salt and smoke bluefish. It is believed that a commercial smoked fish of good quality could be developed with study. The principal markets are in the cities along the Atlantic seaboard, especially Baltimore, Philadelphia, New York and Boston. The demand is greater than the catch, and the price of bluefish is usually high.

SWORDFISH

140. The swordfish, called broadbill by anglers to distinguish it from marlins, is a resource of world-wide distribution. As a food fish, it is one of the most precious, the demand for it far exceeding the supply. Except during the war years of 1942-43, the take of swordfish in New England has always exceeded one million pounds, reaching a peak of 6 million pounds in 1929. Since 1948, the catch has dropped to a low of 199,000 pounds in 1950. Swordfish are marketed entirely as fresh or frozen fish. It is among the highest priced fish on the American market. Oil taken from the liver has a vitamin A content of high potency.

141. To anglers, the swordfish is probably the richest trophy obtainable; it is an exceedingly difficult game fish to catch with rod and reel, and the most expensive, for it requires a special kind of boat and special equipment. The best-known angling grounds are the Block Island district on the east coast and the Channel Islands region on the west coast. In normal times, some enthusiasts go to such distant places as Nova Scotia, Peru or Chile, where good grounds are located.

142. Very little is known about swordfish. They are found close to our coasts only in large sizes. Very young specimens have been reported from the Gulf Stream off Florida to Cuba, but breeding grounds have not been located on this side of the Atlantic. Both eggs and young have been taken from the Mediterranean and young swordfish are common around Hawaii.

143. Probably, like tuna, they migrate vast distances across the oceans, but the course and extent of these migrations are unknown. Nothing is known about the growth, age, or abundance of swordfish. No important questions about the swordfish can be answered without scientific research on a trans-oceanic and international scale, with talent and facilities contributed by all the countries sharing this resource.

TUNA

144. The tunas are a world resource, ranging over vast distances and migrating across oceans; and they comprise an important fishery wherever found. United States citizens have a large stake in this marine wealth, for tunas support the most valuable canning industry in this country and they are of great recreational value to thousands of anglers.

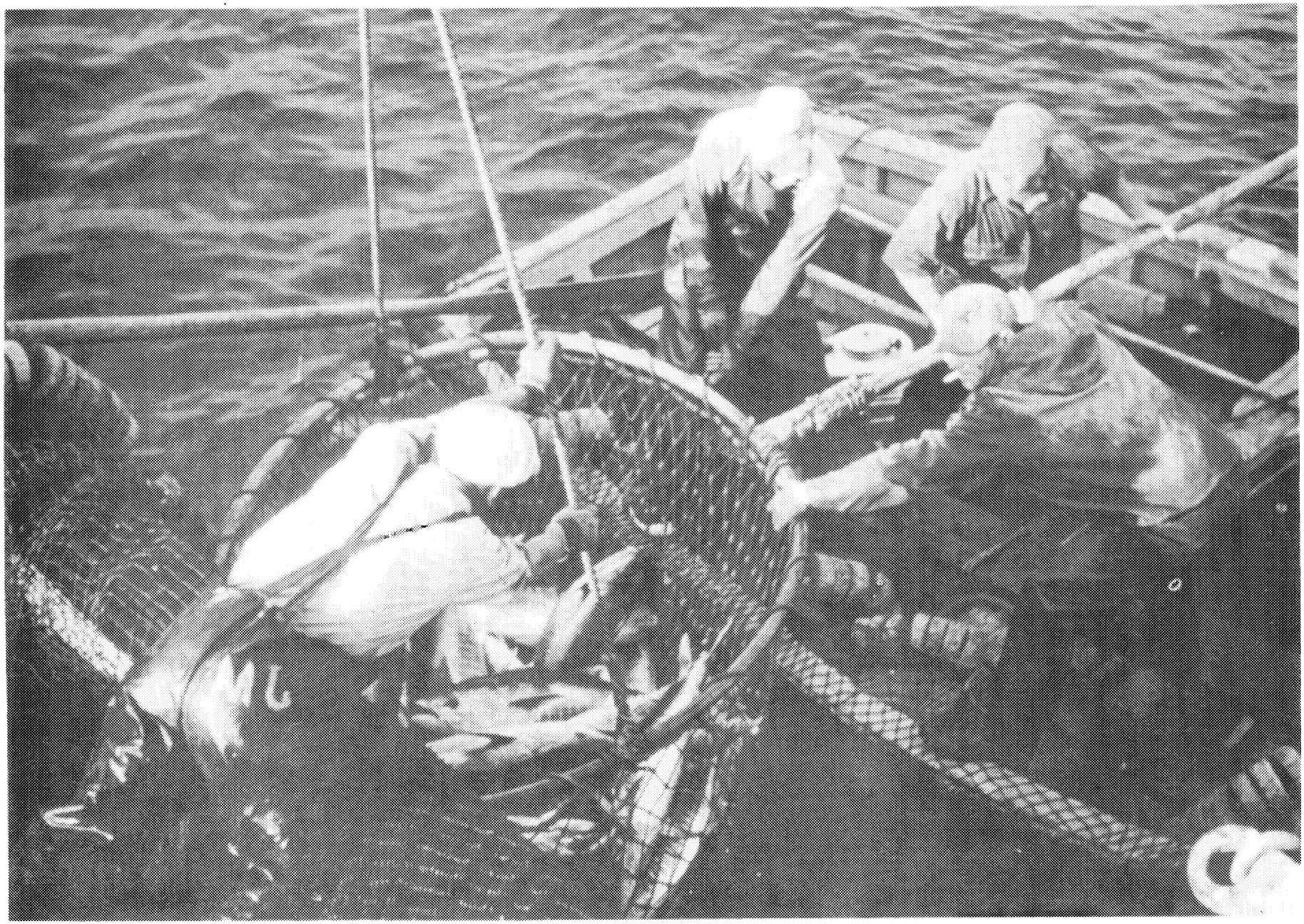
145. On the Atlantic coast, the tunas have a darker flesh and were formerly considered to be less desirable for canning than their Pacific relatives; therefore, commercial fisheries have been slow to develop. On the other hand, they reach their largest size in the Atlantic Ocean and are a prized game fish, being pursued by sportsmen from Florida to Nova Scotia.

146. The bluefin tuna has a more northerly distribution than either the yellowfin or skipjack and attains a larger size than any of the other tunas. On our Atlantic coast, where it is fairly common from Maryland to Newfoundland during a few months of the year, the bluefin may reach a weight of 1,500 pounds, the largest size attained by this species anywhere in the world. Schooling bluefin of 65 pounds or less are common from New Jersey to Cape Cod; the larger fish, of 400 pounds or more, once called horse mackerel, predominate in the north on both the American and the European sides of the Atlantic. During recent years, increasing quantities have been taken by commercial fishermen in fish traps and with hooks-and-lines, harpoons, or nets. It is a favorite with anglers, being taken by rod and line trolling. The commercial catch of tuna in New England waters has been about ~~150,000~~ 1,500,000 pounds annually, but may grow rapidly.

THE INDUSTRY

147. The operating units engaged in the commercial offshore finfishery of New England are listed by States in Tables 3 and 4. The catch by gear is given in Table 5. Data for both tables are for the year 1951, the latest year for which these data are available.

148. Table 3 includes the commercial craft used in shellfish and allied operations as can be seen in the listing for Maine of 4,537 boats of less than five gross tons. Boats in this class are usually engaged in shellfish and lobster activity. Tables 4 and 5 reflect the finfish gear and catch only.



Fishing for tuna. New England-New York Region.

Table 3 - Summary of fishermen, vessels and boats by States, New England commercial fishery--1951,

Item	Maine	N.H.	Mass.	R.I.	Conn.	Total, exclusive of duplication
Fishermen:						
On vessels	1,009	--	4,948	605	405	6,100
On boats & shore						
Regular	5,346	153	1,706	579	104	7,888
Casual	2,468	600	3,950	1,234	1,399	9,651
Total	8,823	753	10,604	2,418	1,908	23,639
*Vessels:						
Motor	157	--	647	131	96	878
Net tonnage	4,952	--	24,410	2,618	1,944	29,503
Steam	--	--	--	--	3	3
Net tonnage	--	--	--	--	191	191
Total vessels	157	--	647	131	99	881
Total net tonnage	4,952	--	24,410	2,618	2,135	29,694
Boats:						
Motor	4,537	209	1,954	1,353	739	8,792
Other	1,827	98	1,450	325	549	4,249
Accessory Boats	14	--	105	35	10	148

*Over 5 tons

Table 4 - Summary of operating units by States, New England commercial finfishery--1951.

Item	Maine	N.H.	Mass.	R.I.	Conn.	Total, exclusive of duplication
Apparatus:						
Purse Seines:						
Mackerel	6	--	35	2	--	41
Menhaden	1	--	1	2	--	3
Other	57	--	1	--	--	58
Haul Seines	2	--	5	5	85	97
Stop Seines	144	--	--	--	--	144
Gill Nets:						
Anchor	--	--	17	--	--	17
Drift	64	--	53	--	79	196
Stake	5	--	--	--	--	5
Lines:						
Hand	727	450	658	251	199	2,285
Hooks	2,251	900	703	251	287	4,392
Trawl						
with Hooks	11,754	96	143	4	16	12,008
Hooks	648,200	4,800	541,550	1,600	8,000	1,198,550
Troll Hooks	--	--	--	47	--	47
Pound Nets	--	--	73	--	12	85
Floating Traps	8	--	41	16	--	65
Weirs	212	--	--	--	1	213
Fyke Nets, Fish	25	--	--	--	18	43
Dip Nets	109	--	104	--	871	1,084
Bag Nets	38	--	--	--	--	38
Lift Nets	18	--	--	--	--	18
Otter Trawls	143	--	578	135	121	977
Traps, Box	5	--	--	--	--	5
Pots:						
Eel	--	--	44	590	852	1,486
Harpoons	78	--	20	8	2	106

Table 5 - New England finfish catch in pounds by gear--1951.

	Maine	N.H.	Mass.	R.I.	Conn.	Total
Purse Seines	11,113,200	--	13,893,200	2,968,200	751,400	28,726,000
Haul Seines	4,900	--	271,900	177,100	--	453,900
Stop Seines	32,472,400	--	4,597,900	--	--	37,070,300
Gill Nets	4,626,900	--	473,700	--	247,600	5,348,200
Hand Lines	1,318,900	10,500	718,200	907,700	113,700	3,069,000
Trawl & Trot Lines	4,690,100	38,300	14,608,100	5,500	10,400	19,352,400
Troll Lines	--	--	--	9,400	--	9,400
Floating Traps	107,300	--	811,200	6,046,300	--	6,964,800
Weirs	20,040,000	--	--	--	400	20,040,400
Fyke Nets	15,300	--	--	--	20,600	35,900
Dip Nets	3,241,200	--	751,900	--	100	3,993,200
Bag Nets	48,100	--	--	--	--	48,100
Lift Nets	100,000	--	--	--	--	100,000
Pound Nets	--	--	5,328,300	--	148,100	5,476,400
Otter Trawls	114,996,900	--	563,252,800	32,995,000	8,463,100	719,707,800
Box Traps	49,000	--	--	--	--	49,000
Pots	1,100	--	--	32,900	11,100	45,100
Harpoons	111,400	--	144,100	55,000	700	311,200
Totals	192,936,800	48,800	605,328,700	42,007,800	9,773,200	850,095,300

149. These tables illustrate the extent of the commercial finfishery in the several New England States. The otter trawls are the chief method used in the industry, taking over 80 percent of the catch. Second and third types of gear used in each State depended on the type of fish available. In Maine, stop seines and weirs, used in taking herring and other anadromous fish ranked second and third. In Massachusetts, purse seines were used in taking such pelagic fishes as mackerel, herring and menhaden. Line trawls and traps ranked third. The floating traps were important in Rhode Island in taking shorefishes such as tautog and eels, while purse seines were used for such species as menhaden and scup. Purse seines were also important in Connecticut in the offshore fishery, while gill nets were the chief method used in taking shad, an important Connecticut fish.

150. The number of fishing vessels and fishermen have fluctuated since pre-war years. In 1941, there were 18,546 fishermen and 642 vessels engaged in commercial fishing in New England. After a temporary decline during the war, the number of fishermen reached a peak in 1947 with a total of 25,355 employed. The number of vessels reached a high of 948 in 1949. The number of fishermen stabilized in the last three years of record, 1950-1952, at about 23,500 even though the number of vessels increased from 868 in 1950 to 916 in 1952.

151. The industry supported by the offshore finfishery of New England is largely concentrated in the major ports of the fishing fleet. Facilities for wholesaling, freezing, storing and processing fish are centered at Portland and Rockland, Maine, and Boston, Gloucester and New Bedford, Massachusetts. Maine led the New England States in the number of plants

engaged in the production of canned fishery products and by-products in 1950, with a total of 68 plants. Massachusetts followed with 27, while Connecticut and Rhode Island had four and one, respectively.

INTERNATIONAL COOPERATION

152. Since the fishing grounds utilized by New England commercial fishermen also support fisheries of other countries, the condition of the fish stocks is of paramount concern. Although fishery statistics were collected by the several participating nations, no one nation could hope to collect by itself the evidence necessary to clarify the condition of the fish stocks. Further, should the evidence obtained by one nation indicate a need for limitation of the fishing effort, the application of restrictions to fishermen of that nation alone would not work effectively toward conservation of the stocks, but would merely place those fishermen at a disadvantage. Working in formal cooperation, however, the nations which participated in the fisheries in question might carry on coordinated, effective research programs. Should the results of the programs show a need for regulation, uniform restrictions could be imposed on all fishermen exploiting the stocks.

153. Until recently, consideration had not been given to formal international cooperation, and it was not until 1937 that an international conference was called in London. The United States did not participate in this conference. At that time it was considered possible to treat the entire Northwest Atlantic as a single conservation unit. Thus, the international convention for the regulation of meshes of fishing nets and the size limits of fish, which was concluded at this conference, was designed to apply to the entire North Atlantic.

154. The 1937 Convention did not enter into force, however, and the British Government therefore convened other international conferences in London in October 1943 and April 1946 to reconsider this problem. The United States was represented at these conferences by observers, and, after discussion with the other nations contiguous to the Northwest Atlantic, suggested that there were in reality two areas in the North Atlantic which were readily separable because of the nations concerned and the stocks of fish and the problems involved. It was proposed, therefore, that consideration be given to the desirability of separate treatment for the Northeast Atlantic and the Northwest Atlantic. The 1946 conference agreed to this concept and the Convention, which was concluded at that conference, established the eastern boundary of the Convention Area at 42° west longitude.

155. During these years, the United States otter trawl fleet, operating largely on Georges Bank, continued to grow, as did the fleets of other nations exploiting the fish stocks of the Northwest Atlantic, and the danger of depletion of stocks became more acute. Accordingly, the United States Government convened an international conference in Washington, D. C., on January 26, 1949, to formulate an agreement on the fisheries of the Northwest Atlantic. Canada, Denmark, France, Iceland, Italy, Newfoundland, Norway, Portugal, Spain, the United Kingdom, and the United States signed the Convention concluded at this conference on February 8, 1949.

156. The Convention establishes an International Commission for the Northwest Atlantic Fisheries, which is responsible in the field of

scientific investigation for obtaining and collating the information necessary for maintaining those stocks of fish which support international fisheries in the Convention Area. Each signatory Government has one vote in the Commission and may appoint not more than three commissioners who may be assisted by experts and advisors. The Convention Area embraces generally all waters of the North Atlantic except territorial waters north of 39° north latitude and west of 42° west longitude. The Convention Area is divided into five sub-areas on a geographical and biological basis. A special panel of commissioners is established for each sub-area.

157. Each panel is made up of commissioners from those nations which are engaged in current and substantial exploitation of certain fish stocks in the sub-area concerned, except that each Contracting Government with a coast line adjacent to a sub-area has the right of representation on the panel for that sub-area. The panels are responsible for keeping under review the fisheries of their sub-area and the scientific and other information relating thereto. Upon the basis of scientific investigations, they may make recommendations to the Commission for joint action by the Contracting Governments, as well as recommendations to the Commission for studies and investigations within the scope of the Convention which are deemed necessary in the development of factual information relating to the particular sub-area.

158. Although the Commission is primarily an investigatory body designed to coordinate the operation of existing public and private research agencies, the Convention grants it indirect regulatory powers. That is to say, the Commission may recommend to the Contracting Governments joint regulatory action based upon the results of scientific investigations.

However, these recommendations become effective only after they have been agreed to by the Governments who are directly concerned with the sub-areas for which the action is proposed.

159. The Convention also authorizes the establishment of advisory committees to be composed of persons including fishermen, vessel owners, and others well informed concerning the fishery problems of the Northwest Atlantic. It is contemplated that these committees will act in an advisory capacity to the Commissioners of each of the Contracting Governments.

160. The Convention came into force on July 3, 1950, upon ratification by Canada, Iceland, the United Kingdom, and the United States. The Commission held its first meeting in Washington, D. C., from April 2 to April 10, 1951. Denmark, having ratified the Convention on December 4, 1950, was represented at this first meeting as a Contracting Government. The other signatory Governments were represented by observers. An advisory committee composed of State Government officials, representatives of industry, boat owners associations, and fishermen was established and met with the U. S. Commissioners prior to the first meeting.

161. At this first meeting, which was largely organizational in character, the Commission elected U. S. Commissioner Deason, Chairman, and U. K. Commissioner A. T. A. Dobson, Vice Chairman; established standing committees; formulated a budget for its first year of operation; and

organized panels for the sub-areas. During the course of discussions at panel meetings, consideration was given to available scientific information on the fisheries of the sub-areas concerned, and tentative agreement was reached on interim meetings of certain of the panels prior to the second annual meeting of the Commission. A committee on research and statistics was instructed to prepare recommendations for methods for the coordination of research programs in the various countries and to advise the Commission as to improvements considered desirable in the collection of statistics and research programs.

162. Since the Commission acts primarily as a coordinating body and undertakes independent research only when absolutely necessary, the great majority of the research proposed will be carried out by agencies of the various Member Governments, and private research organizations. The U. S. Fish and Wildlife Service, through its laboratories at Woods Hole and Boston, Massachusetts, and its statistics-collecting office in Gloucester, are responsible for the greatest part of the United States' share of the work planned for the coming year.

DISCUSSION

163. The finfisheries of New England are now undergoing a transitional period. Prior to the second World War, the New England fishing industry had little effective competition in supplying the eastern half of the country with as much fish products as the demand dictated. This was due, in part, to a tariff on imported fish products, especially filleted fish, which limited the imports.

164. The Canadian Trade Agreement, which became effective in 1939, gave rise to a reduction in the duty on groundfish fillets. This step did not hinder the development of the New England fishing industry during the war-time period. However, the Government-subsidized expansion of fleets and processing facilities in Canada, Iceland and other countries, built to supply food during the emergency, rapidly changed the picture in post-war years. Due to the fact that inflation had reduced the ad valorem equivalent of the American tariff, the foreign fishing industries found it profitable to keep their wartime built fleet and plants in operation and ship frozen fish to the United States. In addition, the costs of production in this country rose steadily. As a result, the low-cost foreign imports began to replace domestic-caught fish in various markets within the United States. At the present time, most of the fish processed into "fish sticks" in this country are imported. This situation has caused deep distress to the New England commercial fishermen particularly those of Massachusetts, which competes directly with foreign imports. Processors have not been affected in the same way as a result of the fish stick business.

165. In addition to foreign competition, the New England fishing industry has other problems. Among these are: decline in fish populations on the present fishing grounds, competition of other protein foods, and high production costs.

166. The possible solutions to these problems have undergone long and careful scrutiny by all concerned with the New England commercial fishery. The program which evolved was presented to the 83rd Congress as part of S-2802, "A Bill to Further Encourage the Distribution of Fishery Products, and for other purposes." This Bill was signed into law in July 1954.

In effect, this law requires that 30 percent of the tariffs collected on imported fish and fish products shall be used in a program to assist domestic fisheries.

167. Major emphasis has been placed on research activities. This is due in large measure to the success of research already underway, particularly that concerning the haddock. Based on research data, it is now possible to predict the annual catch and the work on net mesh sizes has resulted in both an increased catch and conservation of young fish.

168. The program for New England was developed by the New England Fisheries Committee. This Committee is composed of the great bulk of the commercial fishermen, fish processing companies and State agencies. Whether or not the program outlined will develop the data required to keep the New England fisheries on a stable basis is a question of time alone.

169. The program, as outlined during the hearings on S-2802, is as follows:

A PROGRAM FOR NEW ENGLAND FISHERY RESEARCH

An integrated, comprehensive program of fishery research is naturally divided into five parts as follows:

I. Biological-oceanographic research necessary for a sane conservation program leading to an optimum annual crop from the sea.

II. A statistical program necessary for maintenance of authentic records of landings and prices for use of industry and as an aid to the biologist. Market news service is essential in keeping industry informed as to current market conditions.

III. Exploratory fishing and gear development to discover new fishing grounds and to improve methods of detecting and capturing fish.

IV. Technological studies to develop better methods of preserving, processing, distributing, and marketing fish and fishery products. Development of new uses for various species of fish and waste is an essential part of this program.

V. Education and market development. This would be a program designed to promote and stimulate wider use of fish.

Each of these parts is outlined herein.

Part I. Biological-oceanographic research

The stocks of marine fish upon which the New England fishing industry depends are subject to great variations in abundance. There is a year-to-year fluctuation and sometimes great trends develop. Sudden drops in abundance can be disastrous, as in the case of the disappearance of the California sardine.

Depletion of a fish stock can result from overfishing or may be caused by natural conditions. It is the fishery biologist's responsibility to determine the causes of any variations in abundance.

To do this, it is necessary to understand the biology of the species concerned, to assess the effect that variations in natural conditions have on these species, and to know precisely how various levels of fishing effort affect the stocks fished.

A program to furnish the necessary information for such studies in New England includes an investigation of the biology of the important commercial species and regular hydrographic surveys to provide a continuous record of environmental conditions.

Following is an outline of the problems which must be solved if the management of the New England stocks is to be placed upon a sound basis:

(1) Measurement of the effect of the mesh regulation for haddock fishing. In order to determine exactly how the mesh regulation is affecting the stocks of haddock on Georges Bank, it is necessary to continue a detailed study of the population dynamics of that stock. This requires a careful analysis in ports and at sea of fish caught and fish landed by the regular commercial fleet and by vessels licensed to use small mesh nets.

(2) Prediction of the fate of the Georges Bank and other haddock populations. With or without regulation, the New England haddock stocks are in a precarious condition. Fishing has been too intense over the years and there is evidence of climatic change which may have a very serious effect on this fishery. Predicting the fate of these stocks or explaining changes in abundance requires a thorough knowledge of the effect which temperature, currents, and other hydrographic features have on the survival of the eggs and larvae. An annual census of young of the year and of 1-year-old fish is also essential. Studies of food habits and fluctuations in abundance of food are part of this program.

(3) The biology of redfish. Research on this species is designed to determine how long the North Atlantic stocks can withstand present rate of exploitation and to determine how, if ever, the nearby New England stocks can be restored.

(4) The biology of whiting. The exploitation of this species is increasing. Can this be safely done without seriously depleting the resource?

(5) The biology of flounders. Research on those valuable species is designed to protect them against overfishing and the depredation of the trash fishery. Important questions of climatic change are also raised in the case of this fishery.

(6) Biology of scallops. The valuable New Bedford scallop fishery has been maintained by the fishermen moving from bank to bank as individual beds are fished out. How long can this go on? Research on this species is designed to determine how new beds are formed, how fast the shellfish grow, and how much fishing they can withstand.

(7) Clam and oyster research: Studies of the factors influencing the setting, growth, and death of commercial shellfish must be actively pressed forward if production is to keep up with increasing demand. Experiments in protection and culture of shellfish are a vital part of this research.

(8) Environmental factors: The reactions of fish to such environmental factors as temperature, light, and type of bottom result in a fluctuation in their availability. If more were known about the migration of fish on and off the bottom and over extensive areas, much valuable time would be saved by the fisherman in finding the fish in sufficient abundance for successful operations. Development of underwater detection devices can now be applied to this important problem.

(9) Development of continuous recorders: In the study of the effect of environmental conditions on fish stock, it is essential to have continuous records from many locations. Continuously recording devices can be developed to obtain such records at reasonable cost. These instruments can be attached to lightships, buoys, trawls, and anchors.

(10) The biology of the herring and mackerel. A program of herring and mackerel research would be designed to determine whether the Atlantic herring and mackerel are composed of a number of individual stocks and to reveal their history when they leave the range of the American fishery. Transmission of the herring pepperspot disease must also be determined. The research on these species would necessarily be so extensive that a separate 80-foot vessel would have to be assigned to this program.

(11) Effects of inshore dragging: In inshore waters, there is a conflict of interest among the commercial ground fish, lobster, and sport fishery. The question of the effect of dragging on the

bottom, on lobster operations, on sport fish in nearby grounds, and on other species of fish is often raised. A program designed to obtain answers to some of these questions would require the exclusive use of a 60-foot research vessel.

(12) Replacement of antiquated laboratories: The present condition of the Woods Hole Laboratory is an obvious example of conditions that exist in other New England areas.

Part II. Statistical program

The present statistical program and market news service should be expanded to increase the canvas of landings in southern New England and to increase the service of market news.

Part III. Exploratory fishing and gear development

The trend in exploratory fishing research and gear development, especially noticeable in reports from foreign countries, such as England, Iceland, Denmark, etc., is to fish in extreme depths of from 250 to 500 fathoms. It is also the trend to develop new devices, such as sonar, asdic, electric fishing devices, television, etc., for the location of fish. At the present time, the offshore trawling fleet of the North Atlantic area operates under a 12-day trip limit during the winter months and a 10-day limit during the summer months. Owners of the vessels expect highest possible payloads and, consequently, operate on known fishing grounds.

Throughout the Gulf of Maine and from Georges Bank to Grand Bank, there are many areas that await the results of exploratory work before assessment of their value as fishing grounds can be determined. Successful fulfillment in the exploratory fishing and gear development program, while comparatively expensive, would accrue many benefits to the United States fishing industry.

A continuing program of exploratory fishing and gear development research for the North Atlantic area should encompass the following:

(1) Exploration of waters between Georges Bank and Newfoundland for discovery of unexplored fishing grounds for ground-

fish, such as haddock and ocean perch, should be carried out. This would entail research in areas of the Northwest Atlantic hitherto not fished, and also entail the exploration of fishing grounds in waters much deeper than those now fished. New devices such as sonar, asdic, electric fishing devices, television, etc., will be evaluated wherever possible in connection with the exploratory fishing program.

(2) Tuna fishing. Limited research carried out by the Government during the past 3 years indicates that the industry in the North Atlantic area may be on the threshold of establishing a tuna industry. Trials in previous years included fishing for tuna with purse seines, long lines and gill nets. Reports from fishermen fishing for other species of fish indicate that tuna can be caught on a hook and line in many areas of the North Atlantic. A study encompassing the operation of a live-bait tuna clipper for operation in New England waters would, it is believed, add considerably to the knowledge of the evaluation of methods to be used in the capture of tuna and possibly provide the answer to the capture of fish of this species in large commercial quantity.

(3) Shrimp fishing: It is believed there are promising potentialities in establishing a Gulf of Maine shrimp fishery to catch shrimp in sizeable quantities, utilizing medium otter trawlers for fishing in deep water during the period March to August.

(4) Herring fishing: The use of midwater trawls in foreign countries for the capture of herring indicates that the possibility of the adaptation of such fishing gear to the capture of herring in waters off the North Atlantic coast might be fruitful. This type of gear is comparatively inexpensive and might pay off handsomely in the capture of herring. The use of detection devices, such as sonar, asdic, or related devices in the location of fish in midwater is contemplated in connection with a study of this kind. A vessel assigned to herring biological research could be used for this purpose. The study contemplated under this section should be applied simultaneously to the mackerel fishery.

(5) Scallop fishing: Vessel owners, fishermen, and processors are of the opinion that fishing grounds on which scallop draggers now operate are being seriously depleted of this important resource. The North Atlantic scallop fishery is centered at New Bedford and contributes much to the economic health of that community. Discovery of new fishing grounds for scallops are essential if the industry is to continue to thrive. A government operated dragger for use in exploration of new fishing grounds is essential at this time. A vessel assigned to collecting for biological investigation of scallops could be used for this purpose.

Part IV. Technological studies

Funds obtained under S. 2802 (Saltonstall-Kennedy: to further encourage the distribution of fishery products and for other purposes) would enable technological research to be conducted on those basic problems which the industry cannot effectively

handle by giving effect to the recommendations of the Secretaries of State and Commerce and of the United States Tariff Commission to the House Committee on Merchant Marine and Fisheries entitled 'Effect on the Domestic Fishing Industry on Increasing Imports of Fresh and Frozen Fish' (see Document 18 under H.R. 174), in which it is stated on page 68 under 'Recommendation':

> 'In view of the foregoing analysis, it would seem constructive for the Congress to provide funds for the appropriate governmental agencies to cooperate with and aid industry in developing and expanding progress for the further improvement of techniques and facilities for catching, storing, processing, transporting, and marketing of fish.'

The provision that authorizes the Department of the Interior. . . 'to cooperate with other agencies of the Federal Government, with State or local governmental agencies, private agencies, organizations, or individuals having jurisdiction over or an interest in fish or fishery commodities'. . . should be implemented by funds obtained under the Saltonstall-Kennedy bill by cooperating with any recognized established school of fisheries in New England by providing facilities at Government technological laboratories for the training of graduate degrees: thus encouraging the students of these institutions to become interested in the fishing industry.

A continuing program of technological research for the North Atlantic area should encompass the following:

(1) Provision of adequate building and equipment facilities to carry out a comprehensive technological research program. The facilities currently available for carrying out a limited technological program are of wood construction and house a small laboratory and pilot plant. They are in a very poor state of repair and indeed are inadequate even for the current work. The docking facilities at this location are in a state of near collapse.

Facilities in a new building would provide for technological laboratories, pilot plant area, dock gear studies, and graduate student training. Work of the type planned is such that the building and docking facilities be in a major fish-producing center in close proximity to fish-processing plants, freezers and cold storage. It is also necessary that the station be located near educational institutions so that library facilities may be available.

(2) Provision of a suitable vessel and adequate vessel equipment for continuous operation in carrying out technological research, deck gear development, and related research. It is contemplated that the research trawler motor vessel 'Delaware', recently procured from the Department of Defense, will be used for the above studies.

(3) Develop methods for the preservation of fish on fishing vessels so that raw material will be of more uniform quality when landed and payloads of vessels will be larger. This should include research on the freezing of fish, chilling of fish in refrigerated sea water, study of the efficacy of antibiotics, such as aureomycin and others, in the ice that is used for the preservation of fish on vessels.

(4) Research on the byproducts of the fishing industry. This should include basic research on the waste from the haddock, cod, pollock, redfish, and scallop fishery, which is currently thrown away at sea. Investigations into the possible use of waste materials from fish as raw material for isolation of hormones, enzymes, biochemicals and other such products should be carried out.

(5) Research on the food value of some of the newly developed fish products, such as fish sticks, frozen chowders, canned fish products, etc., should be carried out and publicized so that the consumer can be made more fully aware of the excellent qualities of fishery products as food.

(6) An extensive study of the methods used in the handling of frozen fishery products after they leave the manufacturing plant should be undertaken. The adequacy of methods used in transit and frozen cold storage during distribution and at retail levels should be investigated.

(7) Develop new food and nonfood used for species of fish now largely unused; e.g., mud hake, skate, shark, etc.

(8) Develop more fully for use as food such species as pollock, and others that are in great abundance.

(9) Develop physical and chemical tests for freshness of chilled and frozen fish and shellfish to provide means for control of quality of fishery products distributed to the consumer.

(10) Develop industry-approved standards and specifications for fishery products as an aid to efficient and practical marketing.

(11) Maintain a technical service unit designed to advise the fishermen and members of the fishery industries of the results of technological research and methods of industrial application.

(12) Research on the flavor components of fish with a view toward retaining the desirable flavor and increasing the palatability and acceptability of fishery products should be undertaken.

(13) Develop improved fillet processing procedures through pilot-plant study and handling, sanitation, and packing.

(14) Develop improved deck gear on fishing vessels to reduce accidents to fishermen. High insurance rates for fishing vessels make studies of this kind imperative.

Part V. Education and market development

Funds obtained will be used to carry out studies designed to promote and stimulate wider use of fish. Studies would include

fish cookery demonstrations, film showing, and informal discussions before school groups (school lunch), institutions, and service groups of civic nature. Market studies would be undertaken to ascertain the kind of fish products the consuming public likes best.

Summary of estimated costs for entire program

	Capital Investm't	Annual Operating Costs For Adequate Program	Present Allotm't	Additional funds required
Pt. I. Biological-oceanographic research	$1,670,000	$ 792,600	$ 357,100	$485,500
Pt. II. Statistical program	--	115,000	100,000	15,000
Pt. III. Exploratory fishing and gear development	40,000	185,000	15,000	170,000
Pt. IV. Technological research	400,000	330,000	100,000	230,000
Pt. V. Educational and market development	None	35,000	8,000	27,000
Total:	$2,110,000	$1,457,600	$ 580,100	$877,500 "

SUMMARY

170. Since the commercial finfisheries of the several New England States differ rather widely, it is felt that a summary of the present condition in each State would present the pertinent facts regarding the present position and future of the industry.

MAINE

171. The commercial fishery of the State of Maine is the most diversified of the New England Region. Shellfish, particularly lobsters, make up about two-thirds of the value, while finfish account for a third.

172. In recent years, the annual finfish catch has averaged over 250 million pounds, worth over 6 million dollars to the fishermen. The value of the manufactured finfishery products in Maine in 1950 was about 30 million dollars.

173. Ocean perch, a groundfish, and herring, a pelagic fish, are the two major finfish species in the Maine catch. From 1942 to 1949, the herring was the single most valuable fish, with an average catch of over 100 million pounds and an average value of over two million dollars. Since 1949, the ocean perch has assumed first place in value, averaging over three million dollars, although the catch only averaged about 60 million pounds. Other groundfish, haddock, flounders, whiting, cod, hake, pollock and cusk, in that order, comprise the bulk of the Maine catch. Mackerel and smelt are also important species. Other marine finfish taken in the Maine commercial fishery are alewives, butterfish, eels, halibut, menhaden, shad, sharks, sturgeon, tuna and wolffish.

174. Portland and Rockland are the principal fishing ports and the center of the groundfish processing industry. Most of the sardine, or herring industry is centered in the easternmost portions of the State at Eastport and Lubec.

175. Maine is in a most favorable position for the further development of its commercial fishing industry. It has excellent ports, many boat yards and shops, low-cost land for new fish-processing plants, adequate transportation facilities, and a good supply of skilled labor. Not the least important is the fact that the people of Maine are steeped in seafaring lore and are cognizant of the problems connected with the fishing industry.

NEW HAMPSHIRE

176. As might be expected in a State with a relatively small coastline, the commercial fisheries of New Hampshire are minor

in comparison to the remainder of the New England States. In 1952, for instance, the 400 commercial fishermen in New Hampshire comprised less than 2 percent of the total of all New England fishermen while the value of the catch in that year was less than one-half of one percent of the total New England value.

177. New Hampshire's fishermen operate out of small boats and the great bulk of the catch is taken by hand lines, reminiscent of the fishery of Colonial days.

178. Due to the fact that the only deep-water harbor in New Hampshire is almost completely taken over by ship-building concerns and manufacturing interests, there is little opportunity for expansion of the present commercial fishery.

MASSACHUSETTS

179. The Massachusetts finfishing industry is the giant of the fisheries of the New England States. As an example, the value of the haddock landed in 1952 in Massachusetts was over 12 million dollars. All of the finfish landed in the other New England States in that year was worth less than 9 million dollars. In annual average totals, Massachusetts produces between 500 and 600 million pounds, or over 60 percent, of the total New England catch, while the average value was over 32 million dollars, or about 75 percent of the New England total.

180. As in other large industries when problems arise, they are apt to be king-size. Such is the case with the Massachusetts fishery. Prior

to World War II the industry was generally stable and prosperous. During the war period, despite the difficulties encountered, the industry boomed. Following a short readjustment period, the industry entered upon a series of upheavals regarding supply, demand, utilization of the raw product and foreign competition. Massachusetts, it appears, has two industries, one a sick industry engaged in the harvesting and marketing of locally caught fish, the other a flourishing manufacturing and marketing industry using largely imported fishery products.

181. The latter industry is based on the breaded, pre-cooked "fish stick." Production of this item has grown phenomenally since its introduction in 1952. Production in New England rose from 115,000 pounds in January 1953 to over 2,800,000 pounds in December. The production thus far in 1954 is at the rate of 50 million pounds a year or over 4 million pounds a month.

RHODE ISLAND

182. The commercial finfishery of Rhode Island is based on food fish and on "trash fish" which are not edible but are processed and utilized for pet foods, paints, glue and other products. In recent years, the "trash fish" catch has averaged about 20 million pounds, or about half of the total catch. Menhaden, also used in the fish-processing industry, is a major finfish species. Scup, flounders, herring, butterfish, cod and whiting are the chief edible fish. In general, the Rhode Island fishing fleet does not make long journeys to the major off-shore banks but remains in close proximity to its own coastline.

183. The recent decrease in numbers of flounders on the inshore and offshore banks could have spelled disaster to the Rhode Island fishermen if the demand for "trash fish" had not grownat about the same time and taken up the slack in catch. The average value of the commercial finfish catch in Rhode Island in recent years has varied from one million to about a million and a half dollars.

184. The commercial finfishery in Rhode Island is centered at Newport and Point Judith. The Point Judith Fisherman's Cooperative Association, Inc., is an effort by a number of fishing-boat owners to handle the entire process from catching the fish to manufacturing and selling the product. The New England fishing industry is watching this endeavor closely, as its success or failure will, in some large measure, spell out the future of the independent fishingboat owner.

CONNECTICUT

185. Over 90 percent of the commercial finfishery in Connecticut is centered in New London County in the eastern part of the State. Stonington is the major port. The blackback flounder and scup are the two major species followed by yellowtail flounder, fluke, butterfish and "trash fish". In peak years herring, bluefish and mackerel are important. The great bulk of the edible fish taken are shipped to the Fulton Fish Market in New York City.

186. The alewife and shad are the two major species in the rest of the State. These fish are taken in nets as they ascend the rivers to spawn. The average value of the Connecticut catch in recent years has been about $750,000 based on a total catch of about 10 million pounds.

187. Fish processing plants in the State are concentrated primarily on the shad fishery although a few other plants turn out fishmeal and allied products. The menhaden resource could be expanded, but until such plants are operated, the major effort of the Connecticut fishing fleet will be aimed at supplying the fresh fish market in Connecticut and New York City.

Table 5a - Glossary of offshore fisheries,

In order to prevent misunderstanding in the use of common names employed in the tables and discussions, the following list of common and scientific names is given.

Common names	Other common names	Scientific names
Alewife	Branch herring, big-eyed herring, river herring	Pomolobus pseudoharengus
Bluefish	Tailor, skipjack	Pomatomus saltatrix
Butterfish		Poronotus triacanthus
Cod	Codfish	Gadus morhua
Eel:		
Common		Anguilla bostoniensis
Flounder:		
Gray sole		Glyptocephalus cynoglossus
Lemon sole		Pseudopleuronectes dignabilis
Yellowtail	Dab	Limanda ferruginea
Dab	Sea dab	Hippoglossoides platessoides
Blackback	Winter flounder	Pseudopleuronectes americanus
Fluke	Summer flounder, gulf flounder, flounder	Paralichthys dentatus
Haddock		Melanogrammus aeglefinus
Hake:		
Red	Squirrel hake, ling, black hake, mud hake	Urophycis chuss
White	Hake	Urophycis tenuis
Halibut		Hippoglossus hippoglossus
Herring		Clupea harengus
Mackerel		Scomber scombrus
Menhaden	Mossbunker, pogy, fatback	Brevoortia species
Minnow		Cyprinidae family

Table 5a - (Continued)

Common names	Other common names	Scientific names
Ocean perch	Rosefish, redfish, red perch	Sebastes marinus
Ocean pout	Eelpout, sea pout	Macrozoarces anguillaris
Pollock	Boston bluefish	Pollachius virens
Scup or porgy	Porgee, paugy, fair maid	Stenotomus chrysops
Sea bass	Blackfish (Atlantic)	Centropristes striatus
Shad	American shad, white shad	Alosa sapidissima
Sharks		Mustelus species, Carcharhinus species, Sphyrna species, and others.
Skate	Ray, rajafish	Raja species
Smelt		*Osmerus mordax*
Striped bass	Rockfish, rock	Roccus saxatilis
Swordfish		Xipias gladius
Tautog	Blackfish, oysterfish	Tautoga onitis
Thimble-eyed mackerel	Chub mackerel, bullseye, mackerel	Pneumatophorus colias
Tilefish		Lopholatilus chameleonticeps
Tuna; Bluefin	Horse mackerel	Thunnus thynnus
Whiting	Silver hake	Merluccius bilinearis
Wolffish	Catfish	Anarhichas lupas

SECTION II - SHELLFISHERIES OF NEW ENGLAND

INTRODUCTION

1. This section presents a discussion of the extent and value of the shellfish resources of New England; the management and development practices in operation, and measures designed to maintain the shellfish resource and industry. The New York fisheries are not included.

2. Shellfish are an important part of the New England fisheries, since nearly 75 percent of all persons engaged in commercial fisheries are engaged in shellfishing. The total monetary value of shellfisheries in 1952 constitutes almost 40 percent of the total value of commercial fisheries landings despite the fact that the total ratio of shellfish poundage to the total poundage landed is decreasing yearly--from 8.3 percent in 1943 to 6.9 percent in 1952. Table 6 shows the total catch and value of shellfish landed in New England in the period 1940-1952.

3. Since only six species of shellfish make up the great percentage of the total catch and value, each species is discussed separately in this section. General information concerning each form is presented and then the relative value of each species to each of the New England States is discussed.

AMERICAN LOBSTER

4. The lobster is the most important shellfish in New England. In 1952 it made up almost 39 percent of the total shellfish catch

and about 40 percent of the value. The American lobster lives only on the eastern coast of North America from Labrador to the coast of North Carolina. Its range is coastwise extending from the low tide line out to a depth of 600 feet. They are more abundant along the New England coast north of Cape Cod and along the coast of Canada.

5. Lobsters are a bottom inhabitant, living in among the rocks, seaweed and kelp and are nonmigratory, only moving out to the deeper waters during the cold winter months. Specimens weighing more than thirty pounds are taken by trawlers off the New England coast.

6. Mating usually takes place during the summer, and spawning during the following spring. The female carries the eggs, adhering to the underside of her abdomen for a period of approximately ten months. On hatching, the larva are released into the waters where they float freely and begin actively feeding. Lobster larvae feed on organic particles, both dead and alive, and on each other. Lobster larvae grow rapidly, passing through a series of four growth stages, and at the sixth stage, their specific gravity becomes sufficiently high to cause the young lobsters to settle to the ocean floor. The first stage lasts from six to seven days, the second from nine to ten days, and the third stage for nine to ten days. The stages may vary slightly in length according to the water temperature. In the sixth stage the lobster looks like a miniature adult about seven-eights inch long. It then becomes very secretive in habit, living beneath stones and in crevices.

Table 6 - Total catch and value of shellfish* in New England

Year	Pounds	Value
1940	49,961,600	$ 6,297,256
1941	No Data	
1942	45,493,700	8,766,259
1943	46,641,700	10,458,828
1944	43,986,100	10,051,824
1945	51,794,000	15,941,000
1946	60,911,500	20,520,862
1947	63,721,800	20,561,675
1948	59,046,300	21,643,551
1949	68,542,700	19,959,857
1950	64,883,800	21,294,949
1951	66,712,300	22,314,580
1952	61,809,900	26,173,085

*Includes items such as Irish moss, sea urchins, and worms, which are technically not shellfish but are included in the shellfish listings.

7. From 1889 to 1940, the lobster production in New England showed a very definite decline from 30,450,000 pounds to 11,165,000 pounds. Since 1940, there has been a substantial increase to 25,534,000 pounds in 1951. The rise is not as spectacular as the figures indicate, since there are many times the number of fishermen now seeking lobsters. In 1945, lobsters constituted 2.6 percent of the total marine fishery catch by weight and 16 percent of the total value of marine fisheries. Nevertheless, it is felt that there has been a substantial increase in relative abundance.

8. Lobster cultivation has been investigated for nearly 100 years. The earliest work was carried on in Europe using the European lobster. Cultural stations were established in Canada, Newfoundland, and the United States. These stations were devised, not only to hatch and rear lobsters, but to learn something of their habits and development of the larvae. Most have been abandoned as costly and relatively ineffective. Massachusetts has a hatchery now in operation at Oak Bluffs on Martha's Vineyard Island where warmer waters expedite production and reduce costs.

9. In general type of gear used in taking lobster is a lobster pot. This pot is made of lathing and is either rectangular in shape or has a rounded top, depending on the section of New England in which it is used. They have a funnel-type opening on or near either end, usually made of net. The traps are baited with fish or some other suitable material anchored to the bottom in from

Clamming on tidal flats. Plum Island, Massachusetts.
New England-New York Region.

five to 150 feet of water, and are marked by a buoy. Many lobsters are taken each winter by the otter trawls. Those operating far offshore have no provision for handling lobsters and thousands of pounds are returned to the water.

10. Due to their great popularity, the marketing of lobsters is seldom a problem. Lobsters are shipped alive in tank cars and by plane to all sections of the United States. Tremendous storage pounds have been built along the coast so that more stable market conditions have been created.

Maine

11. The rocky Maine coast is ideal lobster habitat, and, as a result, Maine is the greatest producer of lobsters in this country. The spectacular increase in the United States catch has been largely a reflection of the status of the fishery in this State. The 1953 season, with a catch of 22,300,367 pounds, was the largest since the high of 24,452,111 pounds in 1889. From 1912 until 1919, there was a rapid decline in the lobster catch to a low of only 5,500,000. The catch remained low until 1940. A spectacular increase took place between 1940 and 1945 and this high level of production has remained since that time. Maine produces better than 75 percent of the lobsters landed in the New England area at the present time. The State of Maine now has a minimum legal limit of 3-1/8 inches when measured from the rear of the eye socket to the rear of the

Table 7 - Maine lobster landings from 1943-1952

Year	Pounds	Value
1943	17,988,200	$ 7,361,748
1944	13,250,100	2,867,753
1945	17,988,200	7,361,748
1946	18,779,000	7,186,325
1947	18,277,200	6,816,196
1948	15,923,000	6,439,467
1949	19,272,495	6,696,961
1950	18,352,570	6,412,311
1951	20,759,500	7,214,107
1952	20,036,200	8,511,821

carapace or body shell, and a maximum length of five inches. The possession of "berried" or egg-bearing females is also illegal, except when a special license is obtained. A State license is required of anyone fishing for lobsters.

12. The actual value of lobster fishing extends beyond the monetary value received from the wholesale landings. Each summer a great many licenses are sold to Maine residents who fish a small number of pots simply for their own pleasure and food requirements. In addition, the lobster is considered a great delicacy by the summer tourist and no doubt the publicity received is of great value.

Massachusetts

13. Massachusetts is the second most important State in lobster production in the New England area. There has been a gradual increase in production from 1,679,600 pounds in 1924 to a peak of 3,718,600 pounds in 1951.

14. In spite of the long coastline, a great deal of this area is not suited to lobster habitation. The better producing areas are the rocky north shore areas from Salem to Cape Ann in Essex County and Scituate and Cohasset in Plymouth County. The remaining lobster fishery is scattered up and down the coast wherever the coast is suitable. The major part of the Massachusetts coast consists of sandy or muddy bottoms which are not ideal lobster habitat.

15. Massachusetts has a minimum legal limit of 3-3/16 inches from eyesocket to the rear of the carapace. A separate State license is required for lobstermen, but unlike other shellfish, the towns have no jurisdiction over the lobster fishery.

Table 6 - Lobster landings for Massachusetts
1943 - 1950

Year	Pounds	Value
1943	2,518,700	791,080
1944	2,741,200	928,989
1945	2,873,900	1,309,546
1946	3,284,100	1,408,979
1947	3,671,400	1,289,513
1948	3,211,600	1,379,076
1949	3,480,200	1,369,436
1950	3,112,000	1,256,012
1951	3,718,600	1,555,728
1952	3,495,500	1,438,918

New Hampshire

16. New Hampshire usually ranks a poor third in lobster production each year. This is due primarily to the very short coastline. Statistics show a very slow rise in production since 1924, from 125,600 pounds to 1,141,400 pounds in 1943. Since 1943, production has dropped to about half. In value, lobsters constitute about 99 percent of the total shellfisheries crop.

17. A State license is required of all lobster fishermen and all lobsters measuring less than 3-1/8 inches from eyesocket to end of the carapace must be returned to the water. As a further conservation measure, all "berried" females must be marked and returned to the water. Marking is done by punching the center fin of the tail with a punch specifically designed for the purpose. This mark will remain until the female molts after the eggs have hatched. This provision aids in preventing fishermen from removing the lobster eggs in order to sell the lobster as legally taken.

Rhode Island

18. Rhode Island's lobster fishery is small, seldom employing more than 200 fishermen. In general, this can be attributed to the lack of proper habitat. The majority of the fishing is done in Narragansett Bay in the rocky areas off the end of Aquidneck Island in Newport County and the

Table 9 - Lobster landings in New Hampshire from 1943 - 1952

Year	Pounds	Value
1943	1,141,400	$308,450
1944	686,400	171,950
1945	823,700	347,954
1946	--	--
1947	520,000	213,200
1948	401,500	248,630
1949	415,900	166,360
1950	612,700	215,400
1951	531,100	210,132
1952	410,700	164,280

rocky portions of Washington County in Block Island Sound. In value, lobsters make up about 4 percent of the shellfish total. However, a great many are caught by summer residents or used directly by the fishermen so that their value is greater than that expressed in monetary terms.

19. There is no lack of a market in Rhode Island for any lobsters the fishermen might bring in. The summer hotels and restaurants are forced to import lobsters both from Maine and from Canada to supply the demand.

20. The State of Rhode Island requires that each lobsterman be licensed and that each applicant must be a resident of the State. It is illegal for anyone to possess lobsters which measure less than 3-1/16 inches from eyesocket to carapace or to possess egg-bearing lobsters except for sale to State officials. There is a closed season from December 31 to April 1. The State, as of July 1, 1951, closed its only lobster hatchery, having been one of the pioneers in lobster hatcheries in the United States.

Connecticut

21. Connecticut's contribution to the total New England catch is very small, being on a par with those of New Hampshire and Rhode Island.

Connecticut lies near the southern extent of the lobster range and only a very small section of the Connecticut coastline contains suitable habitat.

22. In general, the eastern portion of the State is much more productive than the western. The rocky areas about the mouth of the Thames River and between the Thames River and the Quinnipiac River are seemingly the most productive, together with a small area near the New York-Connecticut State line.

Table 10 - Lobster landings in Rhode Island 1943 - 1952

Year	Pounds	Value
1943	292,400	$ 82,592
1944	234,200	117,100
1945	266,700	133,350
1946	359,800	162,325
1947	392,700	180,701
1948	384,600	176,864
1949	462,600	159,109
1950	226,300	102,530
1951	212,200	92,820
1952	92,000	43,912

23. The Connecticut lobster fishery has shown a decline in landings since 1930. In that year, 735,000 pounds were landed. Since that time, the average catch has been about 350,000 pounds. The State requires that each lobsterman purchase a license each year. Any egg-bearing lobsters and lobsters having an eyesocket-to-carapace measurement of less than 3-1/8 inches are illegal. Each lobsterpot must have an opening of not less than 1-1/2 inch in the bottom presumably to allow for the escape of small lobsters.

Table 11 - Lobster landings in Connecticut 1943 - 1952

Year	Pounds	Value
1943	230,400	$ 82,592
1944	291,500	116,125
1945	314,400	154,771
1946	400,900	192,583
1947	455,100	217,956
1948	305,600	151,870
1949	388,300	169,658
1950	226,300	110,441
1951	312,800	147,889
1952	288,400	141,896

SOFT CLAM

24. The "soft" or "long-necked" clam is commonly found along the entire coast from the Arctic Ocean south to Cape Hatteras. However, they are not found in sufficient numbers south of Maryland to be commercially important.

25. Clams are usually found in the intertidal zone on the sheltered beaches, bays, inlets, and rivers. They are often taken below the low tide line whenever practical. The clam occurs in various types of soils, from rocky gravel to soft mud, but seems to grow best in a mud-sand mixture, which is not subject to sudden shifting due to tide and wave action, where they bury themselves to a depth of six to 12 inches.

26. Cape Cod appears to divide the soft clam range into two distinct areas due to the difference in natural conditions. To the north of Cape Cod, the flat area exposed is much greater due to the wide range of tides and geographical conditions. To the south of Cape Cod, there is less digging area at low tide, and soft clam digging under water is seldom profitable. In these regions, the hard clam and the oyster supplant the soft clam in economic importance.

27. It is estimated that 90 percent of the clams dug in Rhode Island are consumed either by the families of the diggers or by local inhabitants who purchase them direct from the diggers or through small dealers.

28. The soft clam is a dioecious species, spawning early in the spring, and late in the fall in most years. The males and females eject their sex products into the water in great quantities where intermingling and fertilization takes place. Within a very few hours the egg develops into a free-swimming larva form. They remain in this stage for a period of 12 days to three weeks. During this time they are highly susceptible to predation and action of the wind, current, and tide. The spat settles to the bottom where it crawls about on its muscular foot or it may attach itself to nearby objects. When a suitable environment is found, the young clam burrows in and attaches itself. Clams over two inches have difficulty in reburying themselves when exposed.

29. Mortality is very high in soft clams, since their shells are very easily broken and damaged. The larvae are subject to being eaten by fishes, and other shellfish. The adult and spat are preyed upon by horseshoe, blue and green crabs, starfish and boring snails. In addition, diseases are believed to cause heavy losses at times. In many areas hydrogeological changes are the most serious cause of soft clam mortality. When numerous, predators may cause wholesale destruction of the clams in a small area, and as a result, control measures must be taken on clam farms.

30. The green crab has in very recent years become a serious predator on the soft clam. They have extended their range further north, and their numbers have increased tremendously.

Experiments at Boothbay Harbor, Maine, have shown that a single green crab ate an average of 15 clams per day of a size 20mm. or less under laboratory conditions. Other predators such as the rock crab are numerous enough to cause serious damage in New England.

31. The food of the soft clam consists of organic material suspended in the water. This material consists of small plants and animals, clumps of bacteria, and decomposing fragments of larger organisms.

32. The rate of growth of the young clam is subject to variation, due to a large number of environmental factors: temperature, time of submergence, amount of current, amount of food, crowding, and others.

33. Generally speaking, the warmer waters favor increased growth, although excessively high temperatures are detrimental. Those individuals living nearest the low tide range show more rapid growth due to the greater amount of feeding time available. In a crowded environment, the amount of food available per clam is seriously reduced and they, therefore, show less rapid growth. In some instances, entire clam beds have been crowded out of existence by the intrusion of the more hardy blue mussel. They not only reduce food supply, but increase the concentration of waste products in the water.

34. Commercial clams of two inches in length may be produced in one year in Rhode Island, in two to two and one half years in

Massachusetts, and four and a half to five years in New Brunswick. Maine clams under optimum conditions may reach a commercial size their third year.

35. Shell heaps at various points along the New England coastline show that the Indians made good use of clams as food. With the arrival of the first white settlers, there are records to show that they too made use of the clam but only out of dire necessity. Since they depended upon the clam only during periods of privation, a social stigma was attached to those who made use of them. Soft clams were not important commercially until about 1850. Then a large market opened up when the Grand Banks fishermen began to use them as bait. This market continued until 1875 when the fishermen turned to other forms of bait. Their importance declined until about 1885, when the demand for clams in the shells for hotels and clambakes began a general revival at the market. Their popularity increased slowly and shipments to large centers of population began to increase for the same volume of clams.

36. From 1939 to 1942, the rise became steeper and after 1942, the soft clam industry began to assume as high a level of importance as other species of shellfish.

Maine

37. The soft clam industry in Maine ranks second only to lobsters among the shellfish. The Maine coast is ideally suited for soft clam production. It is approximately 2,500 miles long,

indented by innumerable protected long bays and estuaries plus hundreds of island flats. These flats provide a vast intertidal zone due to the great tidal fluctuation along the Maine coast. This fluctuation varies from 6.4-foot average tidal change at Bath to 20.0 feet at Calais. The long, narrow estuaries of the Maine coast line, together with the great fluctuation of tidal levels combine to form an environment with a tremendous flushing of water over the flats, which creates very favorable conditions. In addition, the waters at the head of these bays usually remain a few degrees warmer increasing the length of the growing season.

38. Economically, the State of Maine is divided into two portions by two existing markets. The western part of the State, southwest of the Penobscot River, caters to a retail market. Here, the diggers may sell their product directly to the consumer either shucked or whole. This brings the digger a higher average price for his product.

39. In the northeastern portion of the State, the digger sells his fresh clams predominantly to wholesale shucking houses and canneries. Of necessity, a digger must sell more clams in the eastern side of the State to realize the same profits as a digger in the western portion of the State.

40. There has been a definite decline in the soft clam resources over the State as a whole since the peak year of 1946. There has, in addition, been a gradual shift of production from west to east.

The reasons for the decline of the soft-clam fishery along the southwestern coast are complicated and a source of much debate. It is generally agreed that it probably is not due primarily to fishing pressure, but rather to predators and disease. There has been a gradual increase in average temperature of the waters along the Maine coast, and as a result of this warm cycle, the green crabs have become more abundant and extended their range northward. This change is reflected in the landing figures, which have declined from almost 10 million pounds in 1946 to just over 4 million in 1953. The more recent sets have been more heavily affected.

41. There is no accurate estimate of the acreage of the clam flats along the Maine coast. Each area constantly varies as to concentration and location of clams and only a small portion of the hundreds of square miles of suitable flats are populated at any one time. In addition, the area's limits are determined by the amounts of flats exposed at low tide and are constantly variable.

42. The total value of the soft clam industry to the State of Maine in actual figures is given in Table 12. Since 1945, Maine has landed approximately 50 percent of the total soft clam production of the New England area. In 1946, for example, Maine landed 9,809,500 pounds, with a value of $1,814,676. The total for the entire area was 11,390,500 pounds, with a total value of $2,411,659. Between the years 1946 through 1950, the value of the soft clam averaged 10.6 percent of the value of all marine fisheries.

Table 12 - Maine Softshell Clam Landings 1942 - 1953

Year	Pounds	Value
1942	5,948,100	$ 471,974
1943	4,651,500	596,150
1944	4,275,900	606,222
1945	5,121,800	759,202
1946	9,809,500	1,814,676
1947	7,898,200	1,496,642
1948	8,969,300	1,801,207
1949	8,622,900	1,419,691
1950	6,876,900	1,184,370
1951	5,120,600	1,186,937
1952	5,522,600	1,673,347
1953	4,148,000	1,382,161

43. When taking clams or other shellfish in the State of Maine, it is quite often necessary to have a town license as well as a State license. This is due to the "closed town" laws. The jurisdiction of the State of Maine extends from the low water line out to the three-mile limit and also covers those town areas not regulated by the towns themselves. The State also sets the legal length for clams and also licenses and regulates processors, canners, interstate shipments, shellfish servers, and wholesale dealers.

44. The State employs a number of coastal wardens whose duty is to apprehend violators. The State also has the power to close and restrict the taking of shellfish from any polluted areas.

45. The towns are allowed to issue licenses for commercial digging or propagation and to fix the times and amounts to be taken on their own flats. They are also authorized to enforce their regulations.

Massachusetts

46. Practically the entire coastline of Massachusetts, where there is sufficient shelter from the open ocean, provides a suitable habitat for the soft clam. The names of Ipswich and Duxbury have long been synonomous with the finest and most delectable in clams. Unfortunately, the name lives on but the clam production has fallen far in arrears.

47. Cape Cod serves to divide the clam flats of Massachusetts into two distinct areas. The same species of clam is found north and south of the Cape but the habitats are different. The clam flats to the north of the Cape are large, while to the south of the Cape they are usually narrow beaches. The rise and fall of tide on the north side of the Cape is much higher than that of the south side and consequently many times more acres of flats are exposed.

48. Landing figures indicate that the northern counties produce by far the majority of the commercial clams of Massachusetts. In 1907, Essex County, containing towns bordering on the Ipswich Bay, ranked far above any other county in Massachusetts. Newburyport produced 55,500 bushels, Ipswich

25,000 bushels, and Essex and Salisbury each produced 15,000 bushels, while Boston in the same year produced only 7,500 bushels, and Eastham only 4,000 bushels. At present, Essex County has dropped to third position behind Norfolk and Plymouth Counties, while Massachusetts has dropped to second place behind Maine.

49. The clam flats about the mouth of the Merrimack River were once the most productive in the State of Massachusetts. A great deal of the area has been closed due to pollution from the Merrimack River. Until the pollution is removed, these clamming areas are completely lost as a natural resource. The clam flat areas about Newburyport cover nearly 1,000 acres.

50. The flats of Newbury and Rawley are less extensive than those at the Merrimack River mouth. Thirty acres of flats are open in Newbury and about 50 acres in Rawley. Production has been very poor, due to predators.

51. Ipswich has a clam area greater than 800 acres. A great deal of these flats is covered by blue mussels. The town is undertaking a project to clear those beds and restore their former productivity.

52. The towns of the Ipswich Bay area have only a semblance of their former productivity although the flats are very extensive. However, the northern side of Cape Ann is still one of the more important soft clam areas in Massachusetts.

53. The Boston Harbor area is still the most productive area in Massachusetts although 95 percent of the flats are closed due to gross pollution. Between 170 and 450 million gallons of raw sewage are pumped into Boston Harbor each day. All clams are dug under supervision of a

master digger who in turn hires diggers. All clams taken there must go through the decontamination plant at Newburyport. Many clams are taken to be planted as seed in other areas. Altogether, only about 5 percent of the nearly 2,000 acres of clam flats in Boston Harbor are open. Even so, Quincy, Weymouth and Boston supply nearly 70 percent of the clams dug in Massachusetts.

54. Scituate contains the greatest concentration of clams south of Boston Harbor. The towns south of Scituate and on the Cape have few commercial clam flats although a good deal of tourist and family digging takes place.

55. The town of Barnstable pioneered in leasing clam grants to individuals back in 1910. Massachusetts State law provides that an individual may lease five-acre barren tracts and have sale rights to it. Although some grants are still held, clam farming has not been successful in recent years.

56. Martha's Vineyard and Nantucket Islands are not generally suitable for soft clams except in certain of the salt ponds. They are exposed to the open sea and sheltered tidal inlets and bays are lacking.

57. The State of Massachusetts has, under Section 52 of their general laws, given the local towns control of all shellfish resources within their town lines. This authority extends out to the three-mile limit and they may fix the times, places, methods, purposes, uses, sizes, and quantities so long as they do not violate State laws. The Director of

Marine Fisheries may take over this control if the town itself does not wish to exercise its prerogatives. Each town is required to set aside an area in which commercial fishing is prohibited for the use of private individuals.

58. The Commonwealth laws also provide that a town may issue a license to plant, grow, and take shellfish from an area which is considered barren flats. This license must not run for longer than five years. The Commonwealth also sets a minimum legal length of two inches on soft clams.

Table 13 - Massachusetts Soft Clam Production for 1943 - 1950

Year	Pounds	Value
1943	3,160,800	$ 687,338
1944	4,547,000	1,351,557
1945	2,936,400	1,011,182
1946	1,104,600	420,052
1947	704,100	292,739
1948	625,400	259,395
1949	915,000	375,766
1950	2,974,800	1,100,009
1951	1,693,900	731,897
1952	1,147,100	541,124

New Hampshire

59. The State of New Hampshire has a coastline of about 20 miles, with most of this being open to the sea. The only sheltered waters of any size are Hampton Harbor and Great Bay. Data in Table 14 show a severe decline from 1943 to 1952 in commercial landings. As a result, the State has closed all areas to commercial clamming for a four year period beginning in September, 1953. Digging for personal use will be allowed, however, to legally licensed residents and non-residents.

Table 14 - New Hampshire Soft Clam Production from 1943 - 1952

Year	Pounds	Value
1943	461,500	$ 133,054
1944	236,700	60,272
1945	78,900	22,445
1946	78,900	22,448
1947	21,100	6,330
1948	6,750	1,500
1949	6,000	1,890
1950	7,500	2,000
1951	2,200	687
1952	--	--

Connecticut

60. The Connecticut coast is about 185 miles in length. It is indented by very few bays, river mouth and coves so that most of the coast is open to the sea and the force of the surf. The low tidal range is a major limiting factor and as a result good clam habitat is rather scarce.

61. The waters of Fairfield County are sheltered to some degree by Long Island. These waters together with the few river mouths of New Haven, Middlesex and New London Counties are the principal clam-producing areas of the State. Landing records show that Fairfield County is the major clam-producing county, although New Haven, Middlesex, and New London counties each contribute.

62. Sets are often scattered and poor; therefore, the soft clam fishery is of low value in Connecticut. Digging is not productive enough to support diggers full time and hotels and restaurants are forced to buy clams out of state in order to supply the demand created by summer tourists. Due to the high degree to which oyster farming has been developed, it would seem feasible to encourage soft clam farming. Interest in such farming is high but the rather poor results shown in other states would tend to indicate that farming is not economically sound at the present stage of development. When these biological factors are overcome, it would seem that Connecticut clam industry could be rapidly expanded.

Table 15 - Soft Clam Production in Connecticut from 1942 - 1952

Year	Pounds	Value
1942	34,900	$ 6,092
1943	34,400	6,939
1944	17,200	3,486
1945	26,700	6,529
1946	21,600	6,552
1947	25,000	7,875
1948	21,500	7,440
1949	13,300	4,093
1950	3,700	1,293
1951	1,400	582
1952	400	153

63. The State of Connecticut exercises jurisdiction over all shellfish located within that part of the Long Island Sound bounded on the west and south by the State of New York, on the east by the State of Rhode Island, and on the north by certain designated lines from point to point on the shore, separating the State jurisdiction from the town jurisdiction. To the north of these lines, the shellfish are under the jurisdiction of the

towns except in the towns of West Haven, New Haven, Westport, and Milford. In these towns, the State retains its authority. The State also designates and sets aside certain of the local and State grounds as natural shellfish beds.

64. Within its areas of jurisdiction, the State leases grounds and also requires a license for shellfishing on the natural beds. They have also set a minimum legal length of 1-1/2 inches for soft clams.

65. The towns which have local jurisdiction are allowed to lease grounds, issue licenses, set limits, etc. Several towns such as Stonington and Old Lyme have set minimum legal lengths of two inches for soft clams and nearly all have imposed a limit of the amount taken per man per day.

Rhode Island

66. Although Rhode Island is the smallest State in the Union, it has a shoreline of about 400 miles. Narragansett Bay, with its many miles of inlets, bays and islands, provides suitable conditions for many forms of marine life. Clam flats are abundant, but the relatively small tidal variation of from 3.5 - 4.6 feet does not uncover them. Many of these flats are barren, while still others are grossly polluted. The clam diggers are forced to dig clams beyond the low tide level and they have developed a special method called churning. By this means, they wash the clams out of the soil rather than picking them out visually.

67. Rhode Island supports a rather small soft clam industry, ranking ahead of only Connecticut and New Hampshire. Newport and Bristol Counties are the most consistent producers in the State.

Table 16 - Soft Clam production in Rhode Island from 1943 - 1952

Year	Pounds	Value
1943	171,900	$ 22,489
1944	62,300	10,902
1945	63,900	14,378
1946	51,200	17,934
1947	161,200	93,299
1948	410,700	104,180
1949	259,600	53,428
1950	500,700	174,005
1951	173,800	66,330
1952	83,000	32,133

68. The State of Rhode Island issues a license to all individuals taking more than one bushel per day of clams. Any person having a license is restricted to 20 bushels of clams per day. Licenses are issued to any person who is a resident of the State for one year.

HARD CLAM
(Venus Mercenaria)

69. The hard clam or little-necked clam is usually known to New Englanders by its Indian *name* "quahog" *or* "quahaug" *whereas only* the soft clam is considered a "true" clam.

70. The quahog is found from Cape Cod to Texas. Isolated populations are found in Casco Bay, Maine, Salem, Massachusetts and in the Gulf of St. Lawrence. The hard clam prefers a slightly different habitat than its cousin, the soft clam. It prefers the deeper waters from the low tide range out to a depth of 50 feet. Their life history is much like that of the soft clam. They liberate the sperm and eggs freely into the water, which, after fertilization, are free-swimming larvae, which set after a period of from seven to 24 days. They tend to burrow into the bottom but only deep enough to barely cover the shell. The quahog is taken by several different methods. Practically all of the recreational fishing is done in shallow water using hoes and rakes on the flats and in shallow water and tonging in deeper waters out to 25 feet. Commercial fishing takes place in deep water by the use of dredges and basket rakes.

71. Quahogs are classified for commercial purposes into three groups: "Little necks" which are around two inches in length; "Cherrystones" which are two and a half inches to two and three-quarters inches long; and "Sharps" "Mediums" or "Chowders" which are two and three-quarters inches or larger. "Little necks" command the best market price and they and the "cherrystones" are eaten on the half shell or in cocktails while the "sharps" are used exclusively for clam chowder.

Maine

72. Maine lies at the northern end of the commercial range of the quahog. Their fishery depends on the infrequent sets which occur during warm cycles when reproduction and survival rates are favorable. At such times the quahog fishery in Casco Bay is a highly profitable commercial operation. The coastline of Maine is indented by many long narrow bays and at the head of these bays the water temperature is generally a few degrees higher and the flushing of the tidal waters provides excellent feeding conditions.

73. The only two counties landing quahogs in commercial amounts are Cumberland and Sagadahoc counties. These two counties are the two most southern counties in Maine possessing such long inlets. Maquoit Bay, Middle Bay, and Quahog Bay are among the better producing waters. Private farming has been attempted--2,500 pounds were sold commercially in 1944--but was not carried on intensively after that year. At present, small, but insignificant amounts are produced.

74. Under the auspices of the Department of Sea and Shore Fisheries, several towns in this region have allocated funds to move quahogs from areas where too great a density has built up to barren flats. Good success has been achieved and this work is being continued.

75. The State laws applying to the digging of soft clams also apply to quahogs. The State has set a minimum legal length of two inches and licenses all diggers. Most of the towns have the closed town laws and also require a local license in order to exclude all but local residents.

Table 17 - Hard Clam Landings in Maine from 1943 - 1953

Year	Pounds	Value
1943	78,700	$ 14,180
1944	180,800	41,967
1945	489,400	91,942
1946	168,200	30,251
1947	96,300	27,662
1948	288,700	60,348
1949	598,794	98,483
1950	503,340	98,895
1951	569,000	185,866
1952	424,100	125,632

Massachusetts

76. Massachusetts ranks second in the New England area in the production of quahogs. There is a wealth of tidelands in the State but most of it lies north of Cape Cod and is not as suitable for quahogs as that south of the Cape. This probably explains Massachusetts' relative position.

77. The high-production areas in Massachusetts are the three southern counties: Bristol, Plymouth, and Barnstable. Bristol County is probably fairly typical of good quahog waters. The better producing areas in Bristol County are Buzzard's Bay and the Westport River.

78. The Westport River varies in depth from one to 11 feet with a fairly hard bottom. Buzzards Bay varies from an average of 70 feet at the mouth to 30 feet at the upper end. It has a bottom which is generally muddy but firm. The Bay itself is well protected from all directions but the southwest.

Table 18 - Hard Clam Production of Massachusetts from 1943 - 1952

Year	Pounds	Value
1943	1,560,400	435,078
1944 (public)	1,187,300	465,074
(private)	20,800	5,103
1945	2,259,600	675,338
1946	2,276,500	665,508
1947 (public)	1,952,600	587,130
(private)	14,500	3,960
1948 (public)	1,482,800	475,119
(private)	12,100	2,449
1949 (public)	1,665,300	344,871
(private)	132,000	48,675
1950 (public)	1,986,200	633,007
(private)	27,400	11,445
1951 (public)	2,098,700	769,873
(private)	74,300	31,824
1952 (public)	1,818,700	712,597
(private)	25,800	12,702

79. The Commonwealth provides for private grants to individuals for raising clams and oysters, but leaves the distribution of licenses to the individual towns.

Rhode Island

80. Rhode Island ranks first in production of hard clams in New England but third on the Atlantic coast following New York and New Jersey. The majority of the quahogs are taken from the waters of the Narragansett Bay with some from the Seaconnet River, Point Judith Pond, and Little Narragansett Bay.

81. A great deal of Narragansett Bay is ideally suited for quahog production. They are apparently very plentiful; so plentiful that the lower reaches of the bay are often little fished. Most of the fishing is done by hand tongers or bullrakers since the waters are generally less than 25 feet deep and ideally suited for that type of fishery. Power dredges are prohibited in the State except at the mouth of the Sakonnet River where they may operate between the hours of sunrise and sunset from December 1 to March 31. Hand tongers or rakers are allowed 20 bushels per day and dredgers are allowed 30 bushels per day.

82. At present, the quahog population is maintaining itself under intensive fishing pressure. Rhode Island permits a one-and-a-half inch legal length which is close to the two inch minimum length allowed by the other States.

Table 19 - Hard Clam Production of Rhode Island 1943 - 1952

Year	Pounds	Value
1943	1,868,400	339,242
1944 (public)	2,180,600	405,597
(private)	5,200	1,199
1945	3,222,800*	633,752
1946	3,034,900	737,466
1947	3,138,600	826,955
1948	3,511,500	1,114,224
1949	2,135,000	469,343
1950	2,371,100	662,616
1951	3,053,600	991,786
1952	3,248,200	1,118,836

*includes 1,311,900 pounds of mahogany quahogs valued at $109,387

Connecticut

83¼ The waters of Fairfield County produce practically the entire hard clam commercial catch for the State of Connecticut, since these are the only sheltered waters outside of a few coves and inlets such as are provided by the Thames, Mystic, and Connecticut Rivers. Consequently, the hard clam production is very limited and of small importance except for recreational purposes. There is practically no commercial fishery as such but quahogs are taken off the oyster beds at the time oysters are harvested.

85. Most of the areas suited to quahogs are occupied by private oyster grants and a great many of these are in polluted waters. Commercial quahog farming is a definite possibility in this area, more so than soft clam farming, since the quahog is a hardier species and the habitat is more suited to it.

85. The State has set a minimum legal width of one-and-a-half inches or one inch in thickness. Otherwise, the regulation of shellfish is left to the towns except on certain designated State areas.

86. Marketing is no problem in Connecticut, since most of the hotels and restaurants are forced to buy their clams from other areas. Probably most of the quahog catch is used by individual families or persons buying direct from the fishermen.

Table 20 - Hard Clam Production for Connecticut 1943 - 1952

Year	Pounds	Value
1943	30,500	$10,070
1944 (public)	17,900	5,588
(private)	5,900	2,509
1945	41,800	14,797
1946	106,000	26,779
1947	58,400	25,160
1948	20,900	9,400
1949	13,300	5,897
1950	10,000	4,010
1951 (public)	39,300	12,805
(private)	9,900	3,668
1952 (public)	37,900	11,297
(private)	400	160

OYSTERS

87. The East Coast oyster is indigenous over a wide range of territory from the Gulf of St. Lawrence to the Gulf of Mexico. The most productive areas are the estuarine bodies from Rhode Island to Texas, the Chesapeake Bay being by far the most productive. The oyster is a highly specialized form with well developed systems for digestion, reproduction, circulation, respiration, and response to stimuli. They are highly adaptable and very hardy, and for that reason they have been transplanted to many regions of the world not possessing them.

88. Oysters are usually found in protected areas in enclosed bays and coves where often the salinity of the water is reduced by inflows of fresh water. They prefer a hard or rocky bottom with good circulation of water and plenty of clean surfaces on which to "set". Often muddy areas with otherwise suitable conditions are resurfaced with shell and other materials, known as "cultch", to provide a hard bottom.

89. Spawning occurs when the water temperature approaches 16.4 degrees C. and at Milford, Connecticut, may commence about the beginning of July and in deep water it may continue until the end of August. There follows a period of larval development for approximately two weeks, after which setting occurs.

90. The oyster is dioecious although each individual alternates its sex from year to year. They are remarkably fecund; it is estimated that a single female may produce as much as several hundred million eggs or more a year. The sex products are ejected into the water where ferti-

lization takes place. The eggs develop into free-swimming larvae which set on a clean surface after a period of about two weeks. The most extensive setting grounds are usually found near river mouths where the major oyster predators, oyster drill and the starfish, are not able to survive because of the low salinity of the water. Oyster farms produce most of the commercial catch. In the New England area only about 1 percent of the oysters are from natural or uncultivated beds. Of all the shellfish and fish gathered from the sea, none respond as readily to cultivation as the oyster.

91. The total output for the New England area is a good deal less than that of other areas. In spite of heavy spawning the conditions are seldom right for a heavy set, and due to the short growing season, it takes a longer time to produce a market-size oyster. However, in value, the price per pound paid for New England oysters is far above that of other regions.

92. Oysters are generally taken either with hand tongs or by oyster dredges. Tongs are adaptable to shoal areas and natural beds where dredging is not allowed. Tonging is very difficult labor and is less used commercially than the dredge. The principle of the dredge is to scrape the oysters from the bottom, and then retaining them in a mesh bag to be raised and dumped. The dredge consists of a framework at the mouth of the bag, with a horizontal bar across the bottom set with teeth. The bag consists of iron rings on the bottom and twine mesh at the top.

93. The oyster industry has not shown any really significant decline lately, although except in Massachusetts, the set has been very poor since 1945.

94. There are two distinct markets for oysters: seed oysters to be shipped to other areas for replanting, and market oysters for consumption as food. The seed oysters are generally those from areas too polluted to allow the oysters to be used directly for food. They are then transplanted to cleaner waters to allow them to acquire their flavor which is typical of certain areas. A great deal of the production of Connecticut consists of seed oysters. In addition, transplanting oysters allows quicker growth due to less crowding and growth to a more uniform shape and size. On occasion, oysters are transplanted as many as five times before being marketed.

Massachusetts

95. Massachusetts ranks last among the New England States which produce oysters since it lies at the northern limit of commercial production and has numerous oyster predators in its waters. The potentialities for oyster culture are, however, excellent, but little use can be made of them due to the reluctance of the towns to lease grounds to individuals. In spite of this, the majority of the oysters taken in Massachusetts are from private grants. Grants are found at Wareham where natural spawning takes place, Chilmark, West Tisbury, and Great Pond which have natural spawning, and Wellfleet which also has natural spawning. At Wareham, a number of marshes were developed for the purpose of raising oysters. There are approximately 500 acres of private shell-

fish grants in Massachusetts, most of which are in the previously named towns. Unfortunately, the exact acreage given over to oyster culture is not known, since a great many are soft clam and quahog grants, or are lying idle.

Table 21 - Oyster Production in Massachusetts 1943 - 1952

Year		Pounds	Value
1943	Public	178,000	34,000
	Private	2,630,000	904,000
	Total	2,808,000	938,000
1944	Public	44,900	22,834
	Private	145,400	74,622
	Total	190,300	96,456
1945	Public	15,800	9,300
	Private	153,300	92,380
	Total	169,100	101,680
1946	Public	14,100	7,068
	Private	191,700	177,279
	Total	205,800	184,347
1947	Public	21,800	11,970
	Private	234,800	140,970
	Total	256,500	152,940
1948	Public	6,500	2,500
	Private	222,800	146,287
	Total	229,300	148,787
1949	Public	97,560	55,386
	Private	134,500	85,455
	Total	232,060	140,841
1950	Public	78,000	43,248
	Private	120,900	70,920
	Total	198,900	114,168
1951	Public	108,800	62,856
	Private	139,300	97,296
	Total	248,100	160,152
1952	Public	232,100	115,784
	Private	64,700	34,430
	Total	296,800	150,214

Rhode Island

96. Rhode Island's annual oyster production ranks second to Connecticut in New England. As in Massachusetts, oysters are generally in the water for only a few months to fatten and acquire flavor. A great many of these transplanted seed oysters are from polluted regions in Massachusetts, Connecticut and Long Island Sound. Sets are not regular or dense this far north, and there has been no good set of oysters in Narragansett Bay since 1925. It is believed that this condition may be due to changes in the watershed flowing into the Bay.

97. There are now 1,844.69 acres of grounds under lease, of which all but 2.8 acres lie in Narragansett Bay. Some lie in the mouth of the Pawcatuck River which is polluted, and they must be moved to other waters for a short period of time.

98. Any inhabitant of the State may take one bushel of oysters from the free and common grounds without a license. Otherwise, an inhabitant must have a license, in which case he may take 20 bushels per day from all except certain designated waters. No oysters may be taken from free grounds with a dredge.

99. The State has power to lease grounds covered by four feet or more of water at mean low tide, except within harbor lines and certain other designated areas. There is no sign of a serious reduction of output, even though seed oysters are rather difficult to obtain.

Table 22 - Oyster Production in Rhode Island 1943 - 1952

Year		Pounds	Value
1943	Public	23,400	7,990
	Private	1,359,500	485,527
	Total	1,382,900	493,517
1944	Public	7,000	2,500
	Private	797,700	473,604
	Total	804,700	476,104
1945	Public	-	-
	Private	915,500	406,588
	Total	915,500	406,588
1946	Public	8,400	3,600
	Private	975,500	464,667
	Total	983,900	468,267
1947	Public	6,300	2,700
	Private	563,100	264,300
	Total	569,400	267,000
1948	Public	70,000	30,000
	Private	838,500	472,487
	Total	908,500	502,487
1949	Public	40,800	202,320
	Private	269,000	134,342
	Total	679,800	335,662
1950	Public	35,000	16,495
	Private	887,100	208,400
	Total	922,100	224,895
1951	Public	-	-
	Private	868,700	490,949
	Total	868,700	490,949
1952	Public	17,500	9,197
	Private	616,100	364,067
	Total	633,600	373,264

Connecticut

100. Oysters are Connecticut's most important shellfish crop, exceeding the combined production of all others. The great majority of Connecticut's oysters are gathered from privately owned or leased lands. Previous to 1915, it was possible to obtain a perpetual franchise from the State Shellfish Commission. As of June 30, 1950, there were 46,038.27 acres held under this arrangement. It is possible for residents and nonresidents to lease oyster grounds, and there are now 4,131.70 acres leased and 9,224 acres are rented.

101. In addition to the beds discussed above, there are natural beds set aside by the State which are not to be leased or rented. They are open to free oyster fishing to any person holding a State license. These are divided into beds under State control and those under town control. Four beds totaling 4,933 acres are under State jurisdiction. They are:

Bridgeport Bed	334
Stratford Bed	3,055
Fairfield Bed and Bar	1,237
Fish Island and Raton Point	307
Total	4,933

102. The bulk of the industry is concerned with seed oyster production. This seed is shipped to Rhode Island, Massachusetts, and New York. The majority of the seed oysters are taken from beds lying within lines established by the Connecticut State Health Department, and in order to be fit for human consumption, these oysters must be transplanted. There are many

brass factories in Connecticut and, consequently, copper salts are found in the waters in those areas. Apparently, oysters have a great affinity for copper salts, and it is necessary to transplant all oysters found in these areas to get rid of the copper taste and color.

103. The State has exclusive jurisdiction over all shellfisheries located in that part of the State bounded southerly and westerly by New York, easterly by the State of Rhode Island, and northerly by certain designated town lines. The State has the right to lease areas for shellfish cultivation within its own jurisdiction as well as within the town lines of certain designated towns, the taxes and proceeds to be turned over to the town. Certain natural beds are set aside, and a State license is required to fish them. Power boats are not allowed on these beds. The period of 1949-50 saw a total of 73 individuals licensed to work on natural beds and a total of 29 boats so licensed.

Table 23 - Oyster Production in Connecticut 1943 - 1952

Year		Pounds	Value
1943	Public	137,000	18,763
	Private	1,045,800	203,403
	Total	1,182,800	222,166
1944	Public	46,100	8,935
	Private	815,100	233,874
	Total	861,200	242,809
1945	Public	28,800	7,732
	Private	1,364,700	546,912
	Total	1,393,500	554,644
1946	Public	22,300	6,392
	Private	838,000	280,470
	Total	860,300	286,862
1947	Public	23,500	7,245
	Private	1,275,700	451,084
	Total	1,299,200	459,329
1948	Public	11,500	3,820
	Private	502,200	226,346
	Total	513,700	230,166
1949	Public	62,100	22,492
	Private	3,023,500	969,629
	Total	3,085,600	992,121
1950	Public	31,000	8,349
	Private	3,546,500	1,111,673
	Total	3,577,500	1,119,912
1951	Public	50,200	19,327
	Private	802,500	345,195
	Total	852,700	364,522
1952	Public	16,700	6,524
	Private	1,262,200	523,903
	Total	1,278,900	530,427

SCALLOPS

104. Along the New England coast there are only two species of scallops of commercial importance, the bay scallop and the giant sea scallop. The bay scallop has a wide range extending from Massachusetts Bay to the Gulf of Mexico. They are usually found in from five to 30 feet of water in sheltered bays and inlets. While the extent of the scalloping area is large, only portions are ever productive at any one time.

105. Spawning begins somewhere about the middle part of June in Massachusetts when the water temperature reaches approximately 60° F. In Rhode Island the season begins about June 1, due to the warmer waters. Those in shallow water spawn sooner than those in deep water. The bay scallop spawns when it reaches maturity at an age of about one year. The species is hermaphroditic with only one kind of cell being ejected into the water at one time.

106. The early period of larval development lasts for a week or more before the scallops "set" or attach themselves in a favorable location. Tagging experiments have proven that there are no extensive migrations undertaken by the scallop.

107. The adult scallop probably has fewer enemies than most of the other shellfish due to its free existence. They are most subject to storms, starfish and shellborers. Since most of the bay scallops do not live long after their first year, it is usually felt that all scallops not showing an annual growth ring should be protected and all others taken.

108. The giant sea scallop differs both in environment and certain anatomical details. The sea scallop is a cold water organism and for that reason in the more southern reaches of its range it is found in extremely deep water. Its range extends from southern New Jersey northward to Canada. It is found in river mouths off Maine in as little as 20 feet of water whereas off Massachusetts it is fished for on the Georges Bank in water as deep as 50 fathoms. This preference seems to be dictated by water temperature.

109. Sea scallops grow rapidly for the first five or six years. In this time they increase 50 percent in weight and are between three and four inches in diameter. The sea scallop differs from the bay scallop in that it is dioecious, and in Maine they spawn just prior to their fourth winter in August and September.

110. The large adductor muscle called the "eye", is the only part of the scallop now used for food. Although the rest of the animal is edible, it is generally discarded.

111. Bay scallops are usually harvested by dredging. The dredge is usually much lighter than those in use for oysters, etc. There is a square iron frame with a scraper bar across the bottom to which a bag is attached capable of holding one or two bushels. These are usually pulled by small boats.

112. Gear used for sea scallops is generally larger and heavier due to the greater depths. In Maine, the boats used are generally lobster boats converted for the season by stepping a mast to be used for hoisting the dredges. The majority of these are in the 30 to 40 foot class. In southern New England where the sea scallops are found off-shore in deeper waters the boats run from 60 to 80 feet.

Table 24 - Catch and Value of Bay and Sea Scallops in New England 1942-1952

Year	Bay Scallop		Sea Scallop	
	Pounds	Value	Pounds	Value
1942	816,600	$375,982	6,164,400	$1,970,076
1943	859,100	364,722	4,842,200	2,069,006
1944	465,400	232,902	4,263,000	1,395,107
1945	858,300	472,411	3,994,200	1,317,233
1946	603,300	559,261	9,578,100	5,355,369
1947	589,100	534,631	13,039,310	6,429,871
1948	1,804,300	1,243,005	12,482,800	6,519,205
1949	1,310,000	922,520	13,980,000	5,168,047
1950	985,700	864,198	13,186,200	6,151,340
1951	1,252,800	959,375	14,444,000	6,470,998
1952	1,188,000	913,465	15,392,100	9,092,869

113. Bay scallops have shown no serious decline in numbers except for the normal year to year cyclic changes. Most of the states now have laws prohibiting taking of scallops not showing the one-year growth line so that overfishing is impossible.

Massachusetts

114. Massachusetts is the foremost producer of scallops in New England producing almost 90 percent of the total catch. Cape Cod constitutes the northern range of the bay scallop although at one time they were found as far north as Boston. At present Plymouth County is the most northern producing county. The bulk of the production comes from the south side of the Cape in the many sheltered bays and ponds found there. Buzzards Bay, New Bedford, Chatham, Hyannis, and Oyster Harbors are some of the better areas on the south side. The salt ponds and harbors of Martha's Vineyard and Nantucket Island are very good areas.

115. In these regions there is ample protected water with a fairly low tide fluctuation and good firm bottom with quantities of eel grass. Only occasionally are these flats exposed. The depth of water over these beds averages from 10 to 15 feet, rarely exceeding 25 feet. Usually only a portion of the total area described is productive in any one year. The men, boats and gear engaged in scallop fishing are strictly transitory with quahog and scallop fisheries supplementing each other. Fishermen in Massachusetts are allowed to take scallops only from October 1 to April 1. All scallops must be adult scallops showing a raised annual growth line. Only ten bushels may be taken per day.

Rhode Island

116. Rhode Island is second in production of bay scallops in the New England-New York area. The majority of the scallops are taken from the waters adjacent to Narragansett Bay, mainly Spectacle Cove, Seaconnet River, Nannaquacket Point, Tiverton, Salt Pond, South Kingston and Little Narragansett Bay. Conditions there are much the same as found in the Cape region. The Bay is well protected with not too much tidal fluctuation and areas of eel grass on which the scallops may set. Newport and Washington Counties in the upper end are the regions having the more suitable waters and are the most productive.

118. It is illegal to take any scallops not showing the one year annual line. All persons fishing for scallops must have a state license if he takes more than one bushel per day for his own use. Dredging is limited to the period from September 15 to January 1.

As in Massachusetts, the men and gear used in scallop fisheries are generally employed in other fisheries for most of the year.

Connecticut

118. Connecticut ranks third in production of scallops in the New England area, since it has very little protected water which is suitable for scallops.

119. The areas of greatest production are New London and Middlesex counties. These areas have more sheltered water which is in natural beds and not taken by private grants. In Connecticut scallops may be

taken only by a scoop net having an opening not wider than 16 inches. All scallops must show an annual ring and must be taken from September 15 to April 1. The most important use is the recreational fishery. Most towns containing scallop beds now restrict the catch to residents and set a limit on the number of bushels that may be taken.

Maine

120. The sea scallop fisheries of Maine is primarily a shallow water fishery within the three-mile limit. Their fishing activity is in waters from 25 feet out to 300 feet deep. Originally the principal dredging grounds extended from the mouth of the Sheepscot River northeast into Penobscot Bay, on through the waters about Deer Island, into Blue Hill Bay and the waters about Mount Desert Island. These are still the principal producing areas although the fishery has been expanded in range and extends from Portsmouth Bay in Kittery at the sourthern end of the state to the northeastern end off Lubec. "The beds are normally oval in shape with the main axis being in line with the current, and the length and breadth varying with the strength and direction of the current." Since they are not a burrowing species, the type of bottom does not seem to matter suggesting that salinity and temperature dictates their habitat.

121. There is a closed season except in certain areas from April 1st until October 31. Most of the scallop fishing is done by lobstermen in their off season. The boat operator is required to have a state license.

MUSSELS

122. There are two types of salt water mussels found in the New England area: The blue mussel and the so-called horse mussel.

123. The blue mussel is found in beds up and down the New England coast in waters ranging from the intertidal zone to out to 30 to 40 feet in depth. This is the same mussel used so extensively for food in Europe. It is highly esteemed, so much so that France has carried on an extensive mussel culture for several centuries.

124. In the United States the blue mussel is little used as a food product and only small amounts are harvested each year. During World War II mussels were canned and an attempt was made to popularize them but the publicity was not extensive enough although their popularity has increased.

125. Mussels are numerous enough in most areas to be very easy to gather since they do not bury themselves as clams do but have one end of their shell projecting above the surface of the mud or they set and attach themselves to piling and breakwaters.

126. At present there is a limited canning industry carried out and they are popular with certain segments of the foreign population in New York. About 75 percent of the mussels are landed and sold in New York City.

127. There is a limited fishery carried on in Cape Cod Bay off Plymouth and very extensive beds were found off Nantucket Island. Most of the mussels landed in New York City are dredged from deep water in Long Island Sound.

128. There are apparently extensive beds open for exploitation. In fact mussels have been encroaching upon the clam flats around Ipswich and they have found it necessary to remove them in order to restore the clam productivity.

129. The gear used does not differ radically from that already in use. Hand picking was not found to be fast enough for commercial purposes. For shallow water, the quahog rakes with the attached basket was found to be most efficient. In deeper waters, quahog or scallop dredges were used very successfully in tests. The only commercial catch in recent years has been in Maine and Massachusetts 67,900 pounds were landed with a value of $11,424.

Surf or Skimmer Clam

130. The surf or skimmer clam, is a large clam usually four to six inches long. It is found on sandy bars on the exposed coasts below low water to a depth of 15 fathoms and at times on exposed flats. It is distributed all the way from Cape Hatteras to Labrador.

131. They spawn from June to August and their early life history is similar to that of the other bivalves. They differ from the other clams in that they lead a very active life. They can move about on their muscular foot or glide through the water. Often they jump along the surface from whence comes the name skimmer clams. They burrow into the sand and move from one part of the flat to the other. There seems to be no definite migration however. Of the New England States, only Massachusetts lands surf clams in commercial amounts. In 1952, 3,200

pounds were taken with avalue of $750.A great deal of the areas which seem to be suitable for surf clams in Massachusetts are barren. Only Billingsgate Shoal in Cape Cod Bay seems to be commercially productive although small numbers occur at the mouths of Barnstable and Plymouth Harbors.

132. The surf clam has come into prominence primarily as a chowder clam due to the decline of soft clams. Apparently all the beds in existence are already known and being fished so that the future of the surf clam rests on natural productivity.

133. The gear used for surf clam fishing is the same as that used for quahogs. In shallow water they are picked up by hand tonging and quahog rakes. In deeper waters they use conventional quahog dredges or hydraulic jet dredges which wash the clams from the sand by means of water under high pressure.

Ocean Clam

134. The ocean clam or mahogany quahog is a cold water species differing in appearance and habitat from the bay quahog. They differ superficially in that the ocean clam has a brownish skin over the shell thereby givint it its name. The ocean clam is a cold water species and along the New England coast they are seldom found in less than 60 feet of water with the greatest concentrations in 80 feet or more. They are found on sand or mud sand bottoms and since dredging is impractical on any other type of bottom it is possible that they are found in equal numbers on rocky bottoms also.

135. During the war, a fishery developed for ocean clams due to the closing of a great many of the other shellfish areas by the armed forces. Approximately 720,000 pounds of shucked meats were landed in 1943. When restrictions were lifted on the other shellfish areas, interest once again turned to the bay quahog and technological improvements made dredging for the sea scallop more desirable. The Commonwealth of Massachusetts and the State of Rhode Island have made extensive surveys in anticipation of a revival of interest in the ocean clam. Extensive beds were found south of Cuttyhunk in Vineyard Sound and in Cap Cod bay north of Barnstable. There are enough beds to support a substantial fishery if a commercial market can be developed.

136. In 1952 only Rhode Island reported landing ocean clam.

MISCELLANEOUS

137. Among the other species grouped with shellfish in commercial reports are rock crabs, blue crabs, squid, periwinkles, cockles, conches, Irish moss, blood worms and sandworms.

138. There are two species of crabs found in the New England-New York area; the rock crab, found from South Carolina to Labrador and the blue crab, ranging from Massachusetts to the northern part of South America. By far the most important in New England of the two is the rock crab. The rock crab is not numerous enough to offer serious competition to the blue crab industry which is concentrated primarily in the

Chesapeake Bay region. The blue crab catch is rather insignificant in the New England area since this is the northern extent of its range. Massachusetts, Maine, Rhode Island and New Hampshire in that order take rock crabs in commercial quantities. Only Connecticut produces large numbers of blue crabs for the market.

139. Squid are landed in all states from Massachusetts southward. They are used primarily for bait for fishing, being very tough and resilient. There is a segment of the Italian population in the larger cities which esteem them for food.

140. Blood worms and sandworms are also highly sought for bait fishing purposes. They are dug on the mud flats with rakes and hoes. Retail prices run from 60¢ a dozen upwards. Commercial diggers average about one or two cents each for them wholesale. Maine produces all but a few thousand pounds.

141. Cockles, periwinkles, and conches are all types of snails which are sold for food both fresh and canned. Those who like them consider them a real delicacy although their use is not too widespread.

142. Irish moss is gathered primarily in Maine and Massachusetts. It is used to make agar-agar and for a cosmetic base. Production is fairly limited.

143. Table 25 shows the production of these miscellaneous shellfish in New England in 1952.

Table 25 - Miscellaneous Shellfish taken in New England - 1952

SPECIES	MAINE		N. HAMPSHIRE		MASSACHUSETTS		RHODE ISLAND		CONNECTICUT		TOTALS	
	Pounds	Value	Pounds	Value	Pounds	Value	Pounds	Value	Pounds	Value	Pounds	Value
Rock Crab	375,400	$ 15,204	4,200	$ 210	1,047,000	$ 51,643	72,000	$6,430	--	--	1,488,600	$ 73,487
Blue Crab	--	--	--	--	--	--	--	--	4,000	$ 383	4,000	383
Squid	1,100	42	--	--	383,200	34,562	415,500	36,989	14,000	943	813,800	72,536
Shrimp	103,900	18,205	--	--	400	45	--	--	--	--	104,300	18,250
Surf Clam	--	--	--	--	3,300	750	--	--	--	--	3,300	750
Conches	--	--	--	--	31,500	3,675	124,600	17,557	44,300	5,063	200,400	26,295
Mussels	287,600	8,735	--	--	67,900	11,424	(1)	(1)	--	--	355,500	20,149
Periwinkles & Cockles	4,700	1,473	--	--	--	--	--	--	--	--	4,700	1,473
Sea Urchins	71,800	2,413	--	--	--	--	--	--	--	--	71,800	2,413
Irish Moss	1,125,000	16,875	--	--	1,286,400	26,445	--	--	--	--	2,411,400	43,320
Bloodworms	210,100	178,312	1,700	1,360	--	--	--	--	--	--	211,800	179,672
Sandworms	157,200	91,109	--	--	2,300	2,675	--	--	200	160	159,700	93,944
TOTALS	2,336,800	$332,368	5,900	$1,570	2,822,000	$131,219	612,100	$60,976	62,500	$6,549	5,839,300	$532,682

144. The New England shellfishery ranks second in total value of the United States and Alaska shellfish industries. The Gulf States rank first due to the great value of shrimp landed. The value of shrimp from this region alone in 1951 totaled over 44 million dollars, which was over 35 percent of the total United States and Alaska shellfish landed value. The total shellfish catch in New England in 1951 was valued at 22 million dollars. The Middle Atlantic States ranked third, with a landed value of 18 million dollars closely followed by the Chesapeake Bay region, whose shellfish catch was valued at 16 million dollars. The oyster catch in these regions is the largest contributor to the total. In the Chesapeake Bay region, the oyster landings in 1951 totaled almost 12 million dollars, while in the Middle Atlantic region the value was over 9 million dollars.

145. In New England, in 1951 lobsters and sea scallops contributed over 80 percent of the total value, while the hard and soft clams, and oysters all returned more than one million dollars to the New England shellfishermen.

146. Except for the soft clam and the oyster, the shellfisheries of New England are in good condition. Maine has maintained its level of soft clam production, but landings in the other New England States have fallen off sharply.

147. The future of the shellfisheries is bright. Pollution, although still a serious problem, is being attacked with great success in all New England States. Recent anti-pollution campaigns in Connecticut and Rhode Island will undoubtedly succeed in eliminating, or greatly reducing, most of the pollution load in their streams and rivers with attendant beneficial effects on marine life. Research aimed at solving some of the problems of the soft clam and oyster fisheries is being given increasing emphasis.

148. Of major importance is the recent passage of legislation designed to assist the commercial fisheries. This legislation, S-2802, will appropriate 30 percent of the monies received from the duties on imported fish and fish products for biological, technological, and marketing studies. The portions of this program which are of importance to the New England shellfish industry include: studies of the biology and environmental factors affecting clams, oysters, and scallops; exploratory fishing for new fishing grounds; studies on use of waste products and technological research on fishing methods and equipment. In addition, an information service is contemplated which could be the means of arousing interest in the under-exploited shellfish such as mussels, squid, and ocean clam.

SUMMARY

149. The New England shellfish industry is an important segment of the New England economic picture. The lobster is the most impor-

tant species followed by the sea scallop, soft and hard clams, and the oyster. The average landed value of New England shellfish is over 20 million dollars annually.

151. Most of the shellfish species are not being over-exploited. Only the soft clam and oyster have declined in catch and value in recent years.

151. The future of the industry appears bright. Recent legislation will provide funds for needed research, while pollution control campaigns in the several states are beginning to clean up important shellfish habitat. The result will be the addition of several million dollars to the shellfish industry.

SECTION III - A SURVEY OF THE MARINE SPORT FISHERY OF NEW ENGLAND

1. The commercial and recreational aspects of the Atlantic Ocean bordering the New England States have long been studied and reported on at some length. Books describing the commercial fishery, its methods and problems have been published. Most New England States and some cities have been, and still are, active in setting up seashore recreational areas. The development, or enlargement of ports for ocean-going traffic is supported by Federal, State, and private interests. In contrast, the growth and development of the marine sport fishery has been of comparatively recent origin and to date, no studies have been made. Although recreational fishing in salt water has been carried on for many years, particularly during periods of great abundance of striped bass, bluefish, mackerel, and flounder, it has only been since the close of the Second World War that the sport gained in interest and participation on a seasonal basis. This rapid growth has been due to several factors, among which the general increase in leisure time and the familiarity and enjoyment of outdoor sports gained by servicemen during the war are perhaps the most important. A case in point is the tremendous increase in hunting, trapping, and fresh-water fishing license sales throughout the country. In New England alone, for instance, the total hunting and fishing license sales jumped from about 877,477 in 1942 to over 1,281,000 in 1952.

2. Another fact which increased participation in the marine sport fishery has been the boating boom. The boating industry is reported to be the sixth largest business in the country. This increase has been due in large measure to the factors mentioned above and to the development of dependable, relatively inexpensive motors and small boats in the 20 to 40-foot class. This development has increased the number of boat owners who spend a good deal of time in the pursuit of fish.

3. Due to the rapidity with which the sport developed, few reliable data are available to indicate the extent and value of the marine sport fishery. In an effort to accumulate such data, a survey was made from July to September 1954, which attempted to determine in each State the present status of the fishery resource; the economic values, including equipment used in the fishery; the number of anglers participating; the annual expenditures; present and potential factors affecting the sport fishery; and management or development practices needed to maintain the sport.

GAME FISH HABITAT OF NEW ENGLAND

4. The total length of the New England coastline, including all of the bays and sounds, is over 3,600 miles. Maine, with over 2,500 miles, has the longest coastline. In order, the remainder of the States ranks as follows: Massachusetts, 760 miles; Rhode Island, 250 miles; Connecticut, 185 miles; and New Hampshire, 20 miles.

5. Cape Cod divides this Coast into two distinct marine habitats. North of the Cape, the temperature of the sea is colder being controlled by the cold arctic waters of the Labrador Current. The warm Gulf Stream

Sport fishing. Surf caster with striped bass. Cape Cod, Massachusetts. New England-New York Region.

is of great influence on the waters south of the Cape. A much greater variety of bottom is found in this stretch of the Coast in contrast to the predominantly rocky bottom north of the Cape. The tidal range is greater north of the Cape, ranging from about six feet at Provincetown to 20 feet at some Maine points. South of the Cape, the range is much lower, averaging less than four feet. These factors have a direct influence on marine life, especially the fish species in each region.

6. Possibly another reason why most migratory fish end their northward movement in the area south of Cape Cod is that this region is better protected from the weather and heavy seas of the open ocean. Long Island Sound, Narragansett Bay, and Buzzards Bay are almost completely protected, while Block Island, Vineyard and Nantucket Sounds are partially protected.

7. The sport-fish species inhabiting the waters off the New England coast vary greatly in their habitat requirements. As a general rule, the region south of Cape Cod is more favorable for the majority of species considered to be sport fish while those fish species which are the object of the commercial fisheries inhabit the region east and north of the Cape.

MARINE GAME FISH OF NEW ENGLAND

8. Of the several hundred species of fish that inhabit the sea off the New England coast, only 30 are regarded as sport fish. These are generally classified into three main groups, the pelagic fishes which frequent the deep water off the coast, the shore fish, commonly found in the shallow waters near the shoreline, and the ground fishes who live on or near the bottom.

PELAGIC SPORT FISH

9. This group contains the big-game fish including swordfish, tuna, marlin and mako shark. Catching these large and sporty fish is usually an expensive undertaking since large boats and specialized tackle must be used.

SWORDFISH

10. To anglers, the swordfish or broadbill, is probably the richest trophy obtainable, since it is exceedingly difficult to catch with rod and reel. The best-known angling grounds in New England are Block Island Sound and adjacent waters during July and August.

11. Very little is known about swordfish. They are found close to our coasts only in large sizes usually from 200 to 400 pounds but sometimes over 1,000 pounds. Very young specimens have been reported from the Gulf Stream off Florida to Cuba, but breeding grounds have not been located on this side of the Atlantic. Both eggs and young have been taken from the Mediterranean and young swordfish are common around Hawaii. Probably, like tuna, they migrate vast distances across the oceans, but the course and extent of these migrations have not been determined. Nothing is known about the growth, age, or abundance of swordfish. No important questions about the swordfish can be answered without scientific research on a trans-oceanic and international scale.

TUNA

12. The tunas are a world-wide resource, ranging over vast distances and migrating across oceans. They comprise an important fishery wherever found. United States citizens have a large stake in this marine wealth,

for tunas support the most valuable canning industry in this country, and they are of great recreational value to thousands of anglers.

13. On the Atlantic coast, the tunas have a slightly darker flesh and were formerly considered to be less desirable for canning than their Pacific relatives. The potential commercial fishery for tuna has been slow to develop in New England. On the other hand, they reach their largest size in the Atlantic Ocean and are a prized sport fish being pursued by sportsmen from Florida to Nova Scotia.

14. The bluefin tuna has a more northerly distribution than either the yellowfin or skipjack and attains a larger size than any of the other tunas. On our Atlantic coast, where it is fairly common from Maryland to Newfoundland during a few months of the year, the bluefin may reach a weight of 1,500 pounds, the largest size attained by this species anywhere in the world. School tuna of 100 pounds or less are common from New Jersey to Cape Cod. Larger fish, once called horse mackerel, predominate in the north on both the American and the European sides of the Atlantic. During recent years, increasing quantities have been taken by commercial fishermen in fish traps and with hooks and lines, harpoons, or nets. It is a favorite with anglers, being taken by rod and line trolling, drifting and chumming.

MARLIN

15. Marlins are the big-game fish of warm tropical and subtropical seas. Like the swordfish and tunas they are distributed around the world and probably migrate over great distances. On the New England coast two species of marlins occur, the white or "skillagallee", and the blue marlin.

Only the white marlin is at all common inshore and ranges in the area south of Cape Cod. This is the smallest member of the family and ranges up to 150 pounds. The blue marlin is not uncommon in the Gulf Stream but is only rarely taken by the New England angler. This species reaches a weight of over 1,000 pounds. Other than the fact that small specimens have been taken in the Gulf Stream in South Atlantic waters, nothing is known of the life history of this family.

MAKO SHARK

16. Most marine sport fishermen only occasionally encounter or catch sharks. Usually the small sand shark is taken while bottom fishing or a larger species is taken while chumming for tuna. In recent years, however, it has been discovered that the mako shark, a member of the mackerel shark group, is full the equal of most big-game fish in size and sporting qualities, since it leads often when hooked. As a result, an increasing number of deep-water anglers have added this fish to their big-game lists. The mako is a

large, exceedingly swift shark, reaching a length of over ten feet. They are usually found well offshore and on the surface during the daytime, spending much of the time basking with their dorsal fins protruding from the water. At night they cruise closer to shore.

17. Other members of the shark group, such as the blue shark, are taken occasionally, but they lack the sporting qualities of the mako. Like most big-game fish, little is known of the mako's life history, habits, or range.

INSHORE GAME FISH

18. This group contains the most widely sought marine sport fish, including the striped bass, bluefish, weakfish, and mackerel. In addition it includes such anadromous fish as smelt, shad, and white perch. All of these fish are migratory to a degree ranging from local migrations to thousands of miles in the case of the bluefish.

STRIPED BASS

19. The striped bass is the premier sport fish in New England. It is the big-game fish of the average salt-water angler and is responsible for most of the fishing effort along the New England coast. A vicious, bull-like fighter, the bass has a long history as a sporting fish.

20. In colonial days huge schools of bass were common along the New England coast as far north as New Brunswick. The colonists netted or handlined such quantities during this period that in 1639 the first law protecting this species was passed by the General Court of the Massachusetts Bay Colony.

21. Bass fishing declined during the ensuing years as the need for fish for food lessened. However, sport fishing for this species continued in a small degree and developed into striped bass clubs composed of relatively wealthy individuals who constructed "bass stands", a platform erected on the rocks of the choice bass concentration points. Each angler used hand-made rods and reels, and was accompanied by a "chummer" and a "gaffer". The art of attracting bass by chumming with cut menhaden was handed down from father to son in those days. At several points along the Rhode Island and Massachusetts coasts, such as Newport and Narragansett, Martha's Vineyard and Cuttyhunk, the remains of such stands are still to be seen.

22. The recent history of striped bass fishing may be said to begin with the taking of the present world record fish in 1913, a 73-pounder. The challenge presented in attempting to beat this record has attracted thousands of anglers into the sport. The lure is heightened by the fact that larger fish are available as is shown by the netting of a 125-pound bass in North Carolina and the occasional sighting of huge bass in the surf or offshore waters. The fact that many fish approaching this record are taken every year adds to this spirit of competition.

23. Perhaps more is known concerning the habits of striped bass than any other marine sport fish. Records of its abundance, range, and feeding habits date back to the 1700's. Its breeding habits were studied during the 1800's when efforts were made to re-establish breeding stocks in rivers depleted by overfishing. Fishing during the winter was apparently very effective in reducing the native stocks of bass in New England rivers. At that time of year, the bass are sluggish and concentrate in the deeper holes in the river and netting was highly productive.

Marine sport fishing. Surf casting for striped bass. Cape Cod, Massachusetts. New England-New York Region.

The migrations of bass have been studied since 1931 when the U. S. Fish and Wildlife Service tagged bass in Chesapeake Bay. Since that time bass have been tagged in many localities along the coast and the resultant data have added much to the knowledge of bass migrations. However, the data collected thus far are not conclusive in determining the migrations, or lack of them, in the several bass concentration areas.

24. The striped bass can also lay claim to holding the record for restrictions placed on its capture. The legislatures of Connecticut, Massachusetts and New Hampshire have declared the bass to be a hook and line fish and prohibited netting in State waters. Rhode Island sportsmen are endeavoring to have a similar bill passed. Most Atlantic Coast states have a 16-inch minimum length limit, and Maine has a six-fish-per-day bag limit. In addition, Chesapeake Bay anglers are not allowed to keep any bass over 15 pounds in Maryland and 25 pounds in Virginia. These restrictions are of immense importance to the New England angler since the Chesapeake Bay spawning grounds are thought by some to contribute as much as 90 percent of the bass migrating to the New England Coast during peak spawning years.

BLUEFISH

25. The bluefish is a pelagic species of widespread distribution in different parts of the world. It is an excellent food fish and is surpassed by none as a sport fish. The commercial catch in New England in 1950-52 averaged about 130,000 pounds. Sport fishermen take bluefish chiefly by trolling, chumming or surfcasting with artificial lures. The quantity taken by anglers has never been determined accurately, but it is estimated

to be at least double the commercial catch. The bluefish is noted for its speed, fighting ability, and viciousness. These factors make it the favorite of many salt-water anglers who drop everything and get out their tackle at the first report that "the blues are in".

26. The biology and life habits of the bluefish have not been studied in detail in this country, and our knowledge is only that obtained by occasional and incidental observations. Bluefish travel in dense schools and are extremely voracious, feeding on all kinds of small fishes. They are migratory but their movements are erratic and are probably controlled by hydrographic conditions. They are taken in the winter in southern Florida, then off the Carolinas in March and April, off New Jersey in April and May, and off southern New England from early summer to mid-fall.

27. Bluefish are believed to spawn in May or June, probably offshore. Young bluefish of the year's spawning come inshore in late May or June and growth during the first summer is rapid. At this time they are known as snapper blues and provide abundant sport with light tackle. Snapper blues average about a pound in weight and the older fish will average from three to five pounds. The rod and reel record is over 20 pounds.

MACKEREL

28. The mackerel is much like the bluefish in its habits in that its range covers a major portion of the Atlantic Ocean; it travels in huge schools; and is subject to violent changes in abundance. These changes

are at least partly the result of wide variation in the size of annual broods. This difference is further increased by the fact that there are two types of year broods, one of which makes an important contribution to the commercial and sport fishery for many years while the other soon disappears. Fluctuations in catch are also caused by variation in habits of the fish, resulting from changing environment.

29. Mackerel spawn from Cape Hatteras to the southern part of the Gulf of St. Lawrence, the principal spawning areas being located between Chesapeake Bay and Cape Cod Bay. The average female produces 500,000 eggs. The eggs drift in the water for four to ten days while they incubate; and the young pass through the larval stage and grow to be a third of an inch long in about 40 days, two inches long in about three months. Adult mackerel average about a foot in length and a pound in weight but records go as high as 20 inches and three and a half pounds.

30. When available, mackerel are eagerly sought by both the commercial fisherman and salt water anglers. It is a very sporty fish on light tackle, and is a choice table fish.

WEAKFISH

31. The weakfish is a fish of many names. In New England waters it is called Squeteague or squet; further south another variety is known as sea trout since it closely resembles in shape and color the inland fresh-water trout. The name weakfish probably arose due to the soft mouth which is characteristic of its family. This fact in no way detracts from its high sporting qualities, in fact, it adds zest to the sport since the weakfish must be played carefully by the angler at all times.

32. The weakfish is the most economically important species of the entire Croaker family in the Middle Atlantic States where millions of pounds may be taken by the commercial fishermen. Its range normally extends from Cape Cod to Florida but since it is subject to population fluctuations, it may be absent in the extremes of its range for lengthy periods of time. For instance, it has not been common for the past several years in Massachusetts or Rhode Island waters but is an important sport fish along the Connecticut coast.

33. The weakfish spawns from May to September in the region from Cape Cod to the Carolinas. The eggs are liberated in the water and float for several days before hatching. Thirty pounds is the record weight for this species but the average fish is about two to three pounds.

GROUND FISH

34. Ground fish is the term applied to many species of fish that live on or near the bottom. These fish are the mainstay of the commercial fishing fleet and many tons of the several varieties are taken by the salt-water angler. Although striped bass, bluefish, and weakfish are the primary prize of the experienced angler, the groundfish catch far exceeds the catch of all other groups both in numbers and weight. This is due to the fact that groundfish during the fishing season are usually sedentary in their habits and once the habitat is located the angler is almost always certain to encounter fish at this location. In contrast, the striped bass "blitz" or bluefish "glut", terms denoting plenty of fish and fast action, may last from an hour to several weeks at any one location. In actuality, the several species of groundfish are the chief source of sport for the tyro and a majority of the experts, since, in addition to their availability, they are numerous enough to satisfy the most ardent of anglers.

FLUKE

35. The fluke or summer flounder must be rated high among the sport groundfish of the Atlantic Coast. It is a large and voracious member of the flatfish family running up to 26 pounds. The average size is over three pounds but "doormats" up to 10 pounds are not uncommon in deep water. Fluke travel in great numbers on the feeding grounds and will take almost any bait. In fact, one of the best fluke baits is a strip of fluke. It is not easily landed since it has amazing speed and knows how to use the leverage of its broad, flat body. It is a shoal

water fish, most common in summer from tide mark out to 50 feet, and prefers sandy or muddy bottoms where it lies partially buried awaiting its prey usually small fish or eels. Some tagging has been done in an effort to trace the seasonal migrations of these fish. Most of the larger fish appear to spend the summer in northern regions--northern New Jersey, Long Island, and southern New England--while the smaller fish tend to be distributed from southern New Jersey to the Virginia Capes. Flounders that have reached a length of 12 inches or more appear to have a tendency to return year after year to the same summer areas where they were tagged and released.

36. Information on the spawning of fluke is meager. It is believed that the fish spawn in the late fall or early winter, when they are moving offshore or have reached the offshore winter area. In the early spring and summer more young fish (less than one year old) are found in the inshore waters of Virginia, including the lower region of Chesapeake Bay, than in more northern coastal areas. From this it is assumed that the southern range of the species may be the most productive spawning and nursery region, from which migrations take place in later years to northern fishing grounds.

WINTER FLOUNDER

37. The winter flounder is so called because it is one of the few fish available to the angler during cold weather. This member of the flatfish group occurs from Labrador to Georgia and is usually found on sandy or muddy bottoms. It is a small fish rarely reaching 15 inches in length or a weight of two and a half pounds. Winter flounder spawn in the

winter and spring in depths of one to three fathoms. The eggs sink to the bottom and stick together in small clusters. The fish grow rapidly and become sexually mature at 8 to 10 inches and 3 to 4 years of age. The fish are relatively non-migratory, moving only to cooler waters outside the bays in summer and back to inside waters in winter. This fish is the blackback flounder of commerce and millions of pounds are taken annually by trawlers on the fishing banks.

SCUP

38. The scup or porgy is an important sport fish because of its constant availability and readiness to accept the angler's bait. This silvery, irridescent fish provides fine sport on light tackle from the Carolinas to Cape Cod.

39. Scup spawn in the inshore waters and bays of New Jersey, Long Island, and southern New England from May to August, but chiefly in June. The same coastal areas serve as nursery grounds. Scup reach an average length of about four inches at the end of the first summer, and by the fifth year have attained an average length of 10 inches and an average weight of three-fourths of a pound. The maximum length reported is 18 inches. Most of the commercial catch consists of fish ranging from three-fourths to one and one-half pounds. Scup move northward and toward shore in the spring, southward, and offshore in fall. The annual catch of the New England commercial fisheries in recent years has been about six million pounds, of which a little over half is normally taken in the winter trawl fishery.

TAUTOG

40. In Massachusetts and Rhode Island this fish is called the tautog, or more simply "tog". In Connecticut, it is known as the blackfish. It is a fish of the rocks, wrecks, and piling in its range from Cape Cod to the Delaware Capes. In these areas it feeds largely on mollusks and crustaceans which its powerful teeth are capable of crushing.

41. Tautog provides two periods of good fishing, the first on their return to shallow inshore waters in the spring after spending the winter in deep water and the second in the late summer and fall after spawning which again takes place in deep water.

42. The tautog reaches a length of over three feet and weighs over 22 pounds. However, anything over 10 pounds is considered a large fish. It takes bait readily, but is not easily captured. Its dogged fight to return to its sanctuary in the rockpile rivals the efforts of the better known sport fish. This fish is undoubtedly responsible for the loss of more terminal tackle than any other fish since line or leader will not long endure if the fish, as often happens, does get back to its retreat.

43. The sporting catch of this species in New England is many times the commercial catch, which in 1953 was over 130,000 pounds. During the winter, the tautog retires into deeper water lying in the mud or in crevices of rocks usually in a torpid state. Fluctuations in the supply of this fish parallel the character of the winters, for great numbers are killed by unusually severe winter weather.

SEA BASS

44. Although the sea bass are most common in the Middle Atlantic States, close to 900,000 pounds were taken by New England commercial fishermen in 1952. In addition, many thousands of pounds are taken by sport fishermen. Like the tautog, the sea bass is a fish of the rocky bottom and, in general, the habits of the two species are similar. The sea bass spawns from May to July, depending on the latitude. The eggs are free floating and hatch in about five days. It is a close relative of the striped bass, but unlike the bass, the sexes are somewhat different in appearance in that the male fin rays are considerably longer.

45. The sea bass adults, fish up to eight pounds, tend to keep offshore while the young are apt to be in shallow bays.

KINGFISH

46. The kingfish is a close relative of the weakfish and, in general, has much the same habits and range. It is, however, a smaller fish since a large specimen will reach only about 17 inches and a weight of two or three pounds.

47. This species is also called whiting, king whiting, or sea sable. It is taken mostly when fishing for fluke or other groundfish.

POLLOCK

48. The pollock, often called the Boston bluefish, is an important sportfish in the region north of Cape Cod. During the spring and fall it comes into the shallow inshore waters where it can be taken by surf-casting or from small boats. During warm weather large party boats are used in the deep waters far offshore. Fish ranging up to 30 pounds are

taken occasionally but the average adult weighs about four pounds.

49. The pollock is an important commercial fish, almost 27 million pounds being taken in 1953. Important as the species is to the United States fishing industry, little is known about its biology, or extent of the resource in American waters.

50. Pollock spawn off the mouth of Massachusetts Bay from October through February. The egg is buoyant and is slightly less than 1/20th of an inch in diameter; it hatches in six to nine days, depending on temperature, and the larvae are less than 1/5th of an inch long. The young drift near the surface for several months, then gradually settle to the bottom. In the Bay of Fundy, pollock average five to six inches by the second spring and about 12 inches by the third spring. By the fourth summer, that is, at three and a half years of age, the fish are from 14 to 18½ inches long. The growth rate in the Gulf of Maine and along the Massachusetts coast is not known.

COD

51. The cod is a deep-water species that follows the cold-water currents from the sub-Arctic to Cape Hatteras. Its value as a commercial fish is well-known and, in addition, is a fine sport fish since it arrives in inshore waters when the southern migration of other game fish starts.

52. The cod is taken the year round by anglers in Maine, New Hampshire and Massachusetts and in the winter by southern New England fishermen when it comes into shallow water.

53. It is a comparatively large fish, the record weight being 211 pounds. The rod and reel record is 57 pounds. The average fish taken, however, lies within the 10-20 pound range.

Other members of the cod family taken occasionally by salt-water anglers are haddock, cusk, and ling. Like the cod, they inhabit the cold, deep waters of the northern Atlantic.

TOMCOD

54. The tomcod is a small relative of the cod, seldom exceeding a foot in length, or a pound in weight. It is noted, however, as the small boys' delight, since it is easily taken from docks and bridges on almost any available bait. The tomcod comes into shallow water from November to February to spawn in the region from Labrador to Virginia.

CUNNER

55. The cunner is, for all practical sporting purposes, a small edition of the tautog. It is the most northern representative of the Wrasse family which typically inhabit tropical waters.

56. Anglers seldom deliberately seek cunners but take them incidentally to fishing for tautog and other bottom species. An occasional large specimen of about two pounds provides good sport but the great majority taken are small, being less than a foot in length.

ECONOMIC VALUES

57. The survey to gather data indicating the extent and value of the marine sport fishery in New England was initiated by contacting the appropriate department in each State to obtain a list of persons most familiar with this activity. A total of 63 persons was contacted directly for their estimates regarding the various phases of the survey. Further data were obtained from additional people who were consulted by the

direct contacts. The data presented are the combined estimates of at least 150 persons most familiar with the marine sport fishery in New England.

58. The questions asked were designed to indicate the present value of equipment invested in the marine sport fishery, i.e., boats and tackle, and the annual expenditures made by marine anglers.

59. The survey was originally planned so that at least two persons in each coastal county would be contacted. In practice, it was found that more were usually required. For example, eleven contacts were made in Barnstable County, Massachusetts (Cape Cod) before all areas were covered. In only a few counties was it feasible to follow the original plan.

60. Each person questioned was requested to estimate the number and average value of the privately-owned inboard and outboard boats used for fishing, the number of boat and shore anglers and the average value of tackle owned by these anglers in his locality. These data result in the value of equipment invested in the marine sport fishery in each State as shown in Table 26. Estimates were gathered in all New England coastal states except Maine. In Maine it was reported that there is only a very slight interest in salt-water sport fishing, mostly by summer residents. The tuna charter boats, however, were estimated to handle 5,000 anglers. The total number of boats shown is not the total number of boats in any one state. For example, in Connecticut, it is estimated that there are over 30,000 boats of all types. Contacts were requested to include in their estimates only those boats which were used by sports fishermen.

Table 26 - Estimated value of marine sport fishing equipment in New England

State	Inboard Boats	Total Value	Outboard Boats	Total Value	Total Anglers	Total Tackle Value	State Total
Conn.	4,870	$25,500,000	8,780	$3,893,000	93,825	$9,101,025	$38,495,025
R. I.	1,355	7,392,500	2,775	951,000	27,675	3,270,000	11,613,500
Mass.	1,845	5,235,235	15,785	3,851,540	112,115	9,632,855	17,719,630
N. H.	80	400,000	155	54,250	5,630	140,750	595,000
Maine	No data	—	No data	—	5,000	No data	—
Totals	8,150	$38,527,735	27,495	$8,749,790	244,245	$21,144,630	$68,423,155

Data in Table 26 show that Connecticut outstrips all other New England States in the number of inboard boats used in the marine sport fishery. This is a logical development since Connecticut does not have the type of coastline or the surf conditions to promote the sport of surfcasting. The Connecticut angler is thus practically forced to fish from boats. The reverse is true in Massachusetts and Rhode Island. Here hundreds of miles of smooth, sandy beaches are available and since the striped bass and bluefish can be taken close to shore, surfcasting from the beach is enjoyed by thousands of anglers.

61. The estimated average value of inboard boats in Connecticut ranged from $15,000 to $3,000 with an average value of $5,329. In Rhode Island the estimates were: $14,000 - $1,800, average $5,455; in Massachusetts, $6,000 - $1,800, average $2,842. The only estimate available in New Hampshire puts the average value of inboards in that state at an even $5,000.

62. The thousands of summer residents along the shore who own outboard boats and motors are responsible for the big lead enjoyed by Massachusetts in this division. An interesting comparison was brought out by the estimated average values of outboard boats for each State. The averages were: $443 for Connecticut, $342 for Rhode Island, $244 for Massachusetts and $350 for New Hampshire. The disparity in averages may be best explained by the fact that Connecticut outboard owners prefer the larger 16 to 18 foot boats with 15-25 horsepower engines. Since the better fishing in Long Island and Block Island Sounds is at a considerable distance from shore, the Connecticut angler found long ago that larger craft are not only faster but much safer.

63. Most of the fishing from outboard boats in Massachusetts and Rhode Island is done in the sheltered bays and coves of Narragansett and Buzzards Bays. Hence the larger and more powerful craft are not essential for the majority of the boat anglers in those States.

64. The estimated number of salt-water anglers in each State is also given on Table 26. In comparison to the number of fresh-water anglers only Rhode Island has more of the salt-water variety, 27,675 to 22,269. The latter figure represents the number of fresh-water fishing licenses sold in 1953. Connecticut comes next with 93,825 salt-water anglers as compared to 101,799 fresh-water licenses sold in 1953. Maine and New Hampshire fresh-water license sales far outstrip salt-water estimates while the 209,283 licenses sold in Massachusetts is about double the estimated number of marine anglers. The survey did not attempt to determine what percentage of anglers fished both fresh and salt water although it is known that many anglers engage in both activities. Also, the survey did not attempt to determine the number of marine anglers that fished in two or more States. Since it is known that some anglers follow the fish concentrations it is possible that the estimates include duplications.

65. The total value of tackle for each state was obtained by multiplying the total number of fishermen by the estimated value of the tackle owned by the average sportsman. In Connecticut, this figure was $97. In Rhode Island, the average marine angler was estimated to have $118 worth of tackle, while $77 was the estimate for Massachusetts anglers. Since New Hampshire anglers use largely inexpensive hand line equipment, their average tackle was estimated to be only $25.

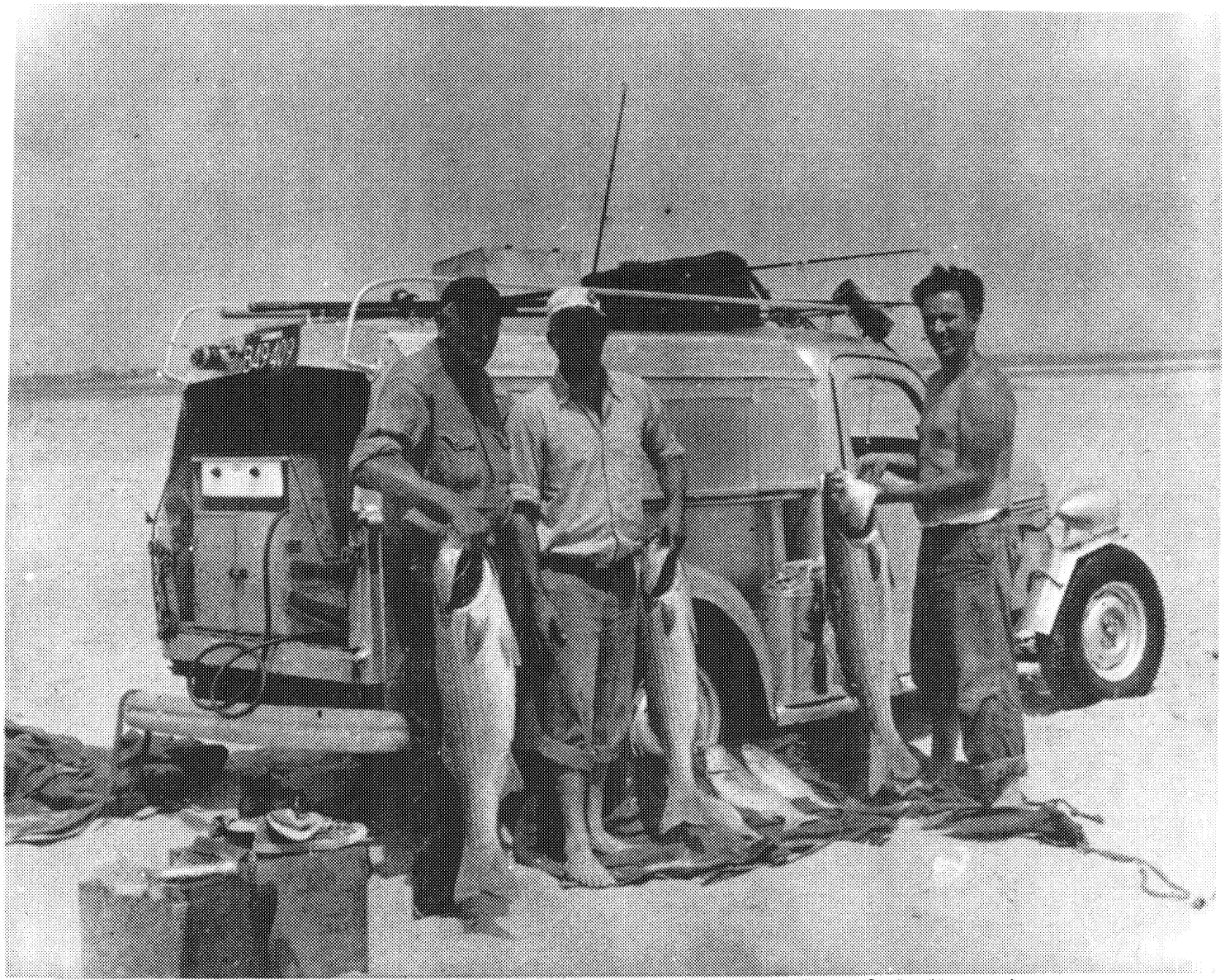
66. Included in the total for Massachusetts is the sum of one million dollars representing the value of the "beach buggies" in that State. The beach buggy is a specially rigged motor vehicle used by surf fishermen to travel on the beaches in quest of sport fish. The basic vehicle may be anything from an ancient Model-A Ford to a late model station wagon or pickup truck. The four-wheel drive jeep is quite popular. The car is fitted with 820 x 15 or 900 x 13 tires and as many gadgets and alterations as the owner finds necessary or desirable. Since many surfcasters spend from several days to a week or more at a stretch on the beach, some of these vehicles are rather elaborately equipped.

67. It was estimated that there are 1,000 of these vehicles in Massachusetts, 850 being members of the Massachusetts Beach Buggy Association, and that the average value was $1,000. No data were collected on beach buggies in the other New England States.

68. It should be pointed out that most contacts, when furnishing data, emphasized that they felt the estimates were on the conservative side. This point was also stressed by several of the State agencies who cooperated in analyzing the data.

69. Since this survey is the first in this field, the State agencies had no formal basis of comparison, their general knowledge of the situation, however, inclined them to feel that the results were reasonable, but conservative.

70. The estimates, if taken to be statewide totals, are definitely on the conservative side since the data do not include sailboats, which are used occasionally for fishing, nor do they include a good share of the boats owned by anglers who bring the boats to the shore on trailers or on top of



Marine sport fishing. Fishermen with striped bass. Cape Cod, Massachusetts.
New England-New York Region.

the car itself. Further, it was not possible to include the outboard motors owned by salt-water anglers and used on rented boats. The value of these alone would undoubtedly add considerably to the total value.

71. Table 27 reflects the estimates on the annual expenditures for marine sport fishing in New England. Included are annual operation and maintenance costs of inboard and outboard boats and the estimated annual expenditures of anglers.

Table 27 - Estimated annual expenditures for marine sport fishing in New England

	Operation and maintenance		Anglers expenditures	Total
	Inboard	Outboard		
Conn.	$3,652,500	$1,975,500	$ 4,691,250	$10,319,250
R. I.	1,016,250	624,375	1,383,750	3,024,375
Mass.	1,383,750	3,551,625	11,361,500	16,296,875
N. H.	60,000	34,875	140,750	235,625
Maine	No data	No data	100,000	100,000
Total	$6,112,500	$6,186,375	$17,677,250	$29,976,125

72. The average annual operation and maintenance costs of both inboard and outboard boats were secured from six boatyard operators, two in each of the three southern New England States. These estimates ranged from $750 to $1,200 and averaged $1,000 for inboards, and from $200 to $500, averaging $300 for outboards. These estimates include all costs of owning and operating these boats, such as depreciation (a large item), gas and oil, repairs, taxes, insurance, replacement of gear, painting and caulking, mooring and storage charges, and miscellaneous items. Estimates were highest in Connecticut and

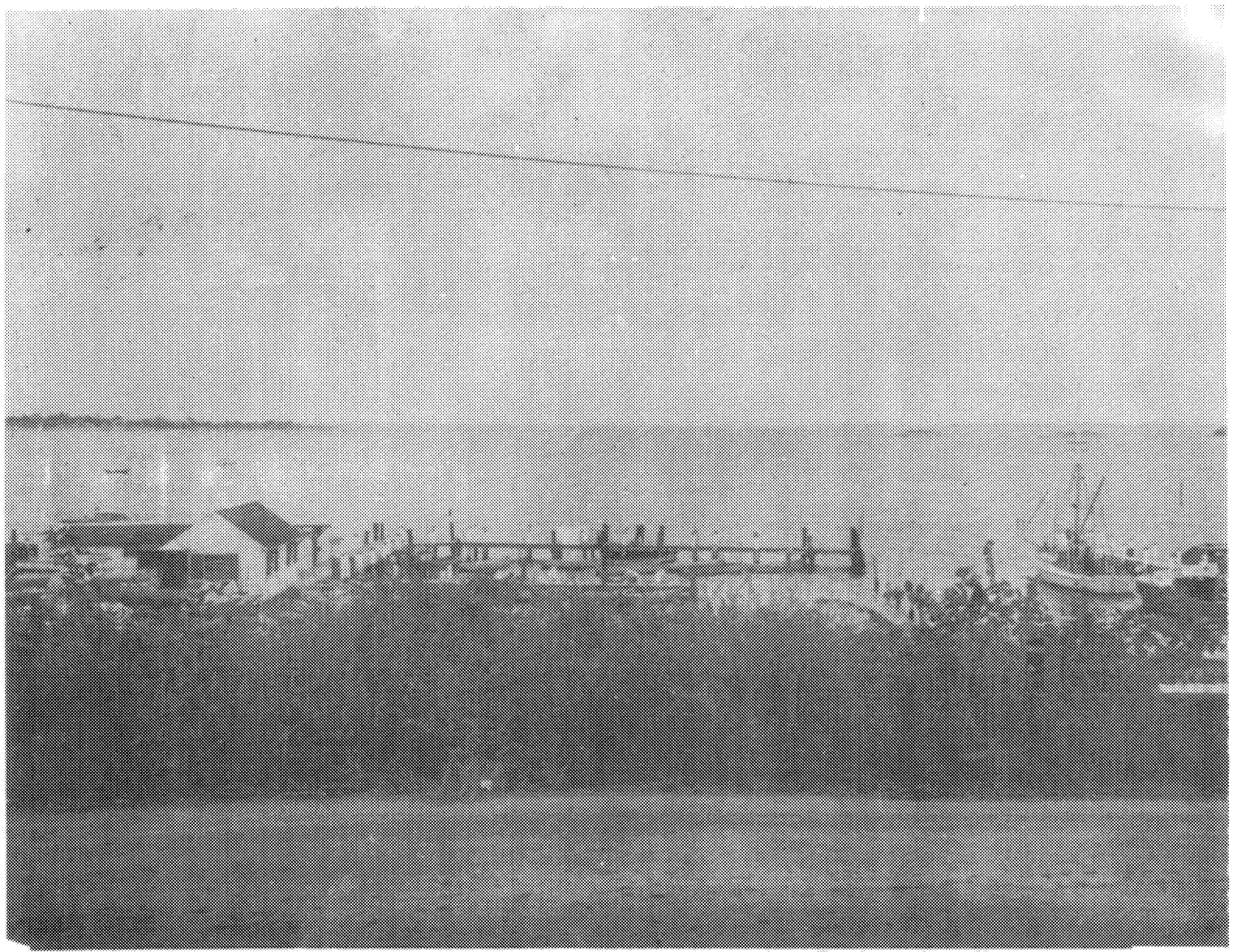
lowest in Massachusetts. However, with one exception, all contacts agreed that the amounts that could be charged to sport fishing were $750 for inboards and $225 for outboards, i.e. 75 percent of the total expenses. Thus the operation and maintenance costs are the result of multiplying the number of boats in each State by these figures.

73. Anglers' expenditures were determined as follows: Estimates as to the number of fishing trips taken by the average angler were collected. These averaged out to ten trips per man per year. The cost per trip was then estimated on an average basis. The list of items considered included, replacement of tackle and gear; boat, locker, and motor rentals; bait purchased; transportation to and from the coast; meals and lodging; special clothing purchased and other miscellaneous items. This included the rentals of charter and party boats.

74. In Connecticut and Rhode Island, the cost per trip was estimated to be $5.00 or a total of $50 a year per angler. In Massachusetts, the cost per trip was estimated to be $10 or $100 a year while the New Hampshire figure was $25.00 per year, or $2.50 per trip. The reason for the additional cost in Massachusetts was primarily the added travel to and from the fishing areas. The reverse is true in New Hampshire where few people outside of those living on the coast, either permanent residents or summer vacationists, fish in the ocean.

75. These figures for each State multiplied by the estimated number of anglers in each State result in the total anglers' expenditures.

76. It is here repeated for emphasis that the data are nothing more than estimates gathered to indicate in a general way the extent of the marine sport fishery.



Marine sport fishing boat livery. Noank, Connecticut. New England-New York Region.

77. Plate 2 , shows the facilities available to the marine sport fisherman. Included on the map are the boat liveries which rent rowboats or skiffs, with or without outboard motors; sell bait and tackle and furnish lockers and mooring sites for the privately-owned inboard and outboard boats. Charter boats and party boats are also depicted. Charter boats are 20 to 40 foot cruisers that pursue big-game fish such as tuna and carry from four to six anglers. Party boats are larger craft, up to 150 feet long, that carry from 20 to 100 anglers and seek the groundfish in the area.

78. The survey revealed that better than half of these facilities have come into being since 1945.

79. It is interesting to note that the consensus among the boat livery operators was that their business has increased over 300 percent since the end of World War II and that all indications point to continued expansion. No data were collected on the use of these facilities by anglers or the amounts of money invested in the land, boats, and equipment.

80. Few data are available from States outside the region as to the expenditure of marine sports fishermen. To date, New Jersey, California, and Maryland are the only states to undertake such work. In 1948, the U.S. Fish and Wildlife Service made a survey of the sports fishery of New Jersey and Long Island. This survey considered only the charter and party boat business and did not include privately-owned boats. The survey showed that in 1948 there were approximately 1000 vessels in the sports fishing fleet of which 600 or more were of the charter boat type. These boats were cabin cruisers, usually of the 25 to 45 foot class. The investment in these boats averaged $15,000 and the total investment was over $9,000,000. There were 400 party boats, average value also $15,000, representing an investment of approximately $6,000,000. The total investment in boats and equipment in New Jersey in

1948 was thus estimated to be $15,000,000

81. Since there are about 300 charter and party boats and about 2,000 rental outboards in the New England States, and if the average value per boat were the same, over $6,000,000 could be added to the value of the marine sports fishery in New England.

82. No data are available to indicate the value of the bait and tackle shops or boat liveries. The sum invested in these businesses, if they could be ascertained, would add considerably to the marine sport fishery value.

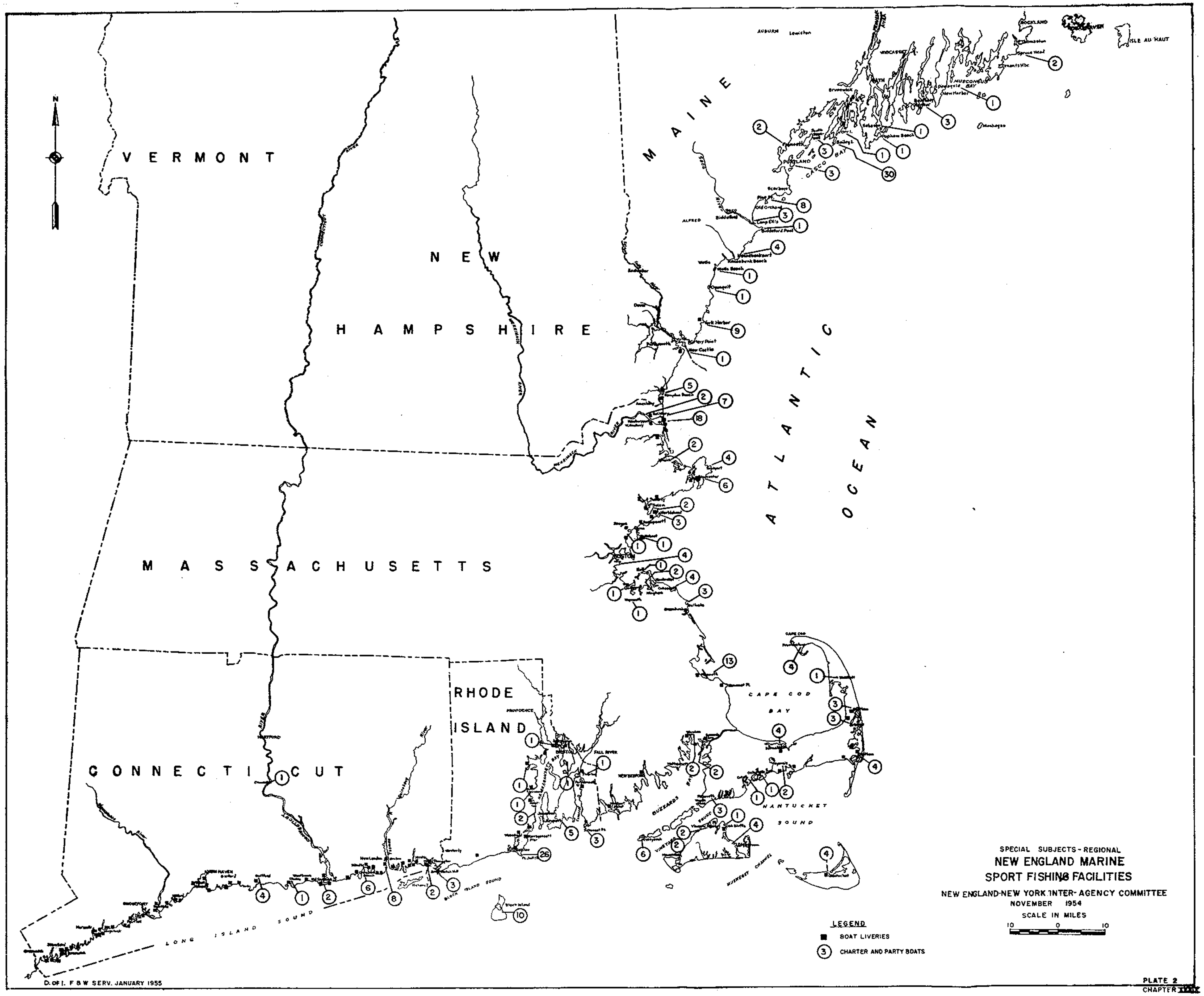
83. In 1953, the California Fish and Game Department compiled data on the average daily expenditure of fishing for striped bass, salmon and steelhead trout in that state by salt-water anglers. Average expenditure for striped bass fishing was $9.18 per day. For salmon the average was $16.09; for steelhead it was $18.11.

84. In 1952, the Maryland Department of Research and Education made an economic study of the Maryland tidewater sport fishery. In this study it was reported that there were about 100,000 fishermen in this area, the average annual expenditure per fisherman was $96.06 giving a total annual expenditure in Maryland of $9,606,000.

85. The above data for California and Maryland compare favorably with the estimates obtained for New England marine sport fishermen.

DISCUSSION

86. The economic survey of the marine sport fishery indicates that this activity is an important recreational and economic factor in the region. In addition to the estimated total of 2,4,215 anglers, about 2,000 individuals are estimated to be directly concerned with this


VERMONT
NEW HAMPSHIRE
MAINE
MASSACHUSETTS
RHODE ISLAND
CONNECTICUT
ATLANTIC OCEAN
CASCO BAY
CAPE COD BAY
BUZZARDS BAY
NANTUCKET SOUND
LONG ISLAND SOUND
BLOCK ISLAND SOUND
ISLE AU HAUT
SPECIAL SUBJECTS - REGIONAL
NEW ENGLAND MARINE
SPORT FISHING FACILITIES
NEW ENGLAND-NEW YORK INTER-AGENCY COMMITTEE
NOVEMBER 1954
SCALE IN MILES
10 0 10
LEGEND
BOAT LIVERIES
CHARTER AND PARTY BOATS
D. OF I. F & W SERV. JANUARY 1955
PLATE 2
CHAPTER

activity for all or a good part of their livelihood. These include the personnel of boat yards and liveries, bait and tackle shops, and the operators of charter and party boats. In addition, many persons are engaged indirectly in catering to the salt-water angler. These include sporting goods salesmen and manufacturers, dealers and commercial fishermen who supply bait, clothing manufacturers and salesmen, boat and motor salesmen and many others.

87. Since the marine sport fisherman is estimated to spend close to 30 million dollars annually, it is now possible to indicate the stimulus of the marine resources of the Atlantic Ocean to the economy of New England. In 1952, the latest year for which data are available, the commercial fishermen received over 41 million dollars for their catch as sold from the boat. The shellfish catch in that year was worth over 26 million dollars. There are no data available as to the amounts spent by commercial fishermen nor are data available as to the recreational and food value of game fish.

88. During the survey an attempt was made to determine the present status of the marine sports fishery and the problems that may affect the present or potential status of the sport.

89. The only major problem uncovered was the conflict between the commercial fisherman and the sporting angler. This situation has been smoldering for a long time. As previously pointed out, this conflict erupted once before and resulted in a victory for the sportsmen when laws were passed prohibiting the commercial netting of striped bass in Connecticut, Massachusetts and New Hampshire. Rhode Island has a similar bill under consideration.

90. The latest phase of the conflict has to do with the effect of the otter trawl net used by the commercial fishermen. The otter trawl is a huge bag net that is dragged close to the bottom, the mouth of which is kept open by two huge wooden otter boards or "doors". These nets are mainly used to take the groundfish on the banks lying far offshore. In recent years, however, the groundfish in southern New England waters have become scarce, particularly the species of the flounder group. As a result, the commercial fishermen of Connecticut and Rhode Island have turned to the so-called "trash" fishery. This is the term used by the industry to denote the fish taken to be manufactured into fertilizer, chemicals, and other miscellaneous items. The trash fishery is not selective and does take all species of fish. Table 28 shows the sport fish taken by commercial fishermen in 1952. The total weight of all species is 44,559,300 pounds. The trash fish catch was 53,012,200 pounds in that year. The game fish catch made up 4.9 percent of the total poundage and 12.5 percent of the total value. In contrast, the trash fishery made up 6.0 percent of the total weight but the $457,798 received for these fish was only 1.1 percent of the total value.

91. The commercial trash fishermen were reported to affect the supply of sport fish in two ways. First, they were alleged to take quantities of sport fish, and second, the trawl nets were supposedly very destructive by "tearing up the bottom" to the detriment of all marine life including sport fish.

92. Other problems mentioned include pollution and channel dredging for navigation. These activities were reported to affect the habitat of fish and to cover the bottoms with silt or other debris. These latter

factors are localized, however, and were not considered too serious.

93. The trash fishery situation is, however, a major problem and is so recognized by all concerned with the marine resources. The Saltonstall-Kennedy Bill, legislation passed by the 83rd Congress to aid the commercial fishing industry by promoting research and technical development has, as one of its major research projects, a study of the trash fishery to determine the effects of inshore dragging on the bottom, on lobster operations and on sport and other species of fish. A 60-foot research vessel will be acquired at a cost of $85,000 and an annual operating budget of $75,000 is proposed.

94. Although research work on the life histories and habitat of game fish was not mentioned as a problem affecting the status of the marine sport fishery, some of the people contacted did point out the paucity of knowledge concerning most species. Population studies, effects of pollution and barriers, such as dams in rivers, were all mentioned as subjects for intensive investigation.

95. Some of the projects outlined in the Saltonstall-Kennedy bill will be of great assistance to the marine sport fishery even though the objective of the research is to assist the commercial fishery. Biological studies of such fish as flounders and mackerel which are both sport and commercial fish are proposed. A study of environmental factors will be of great assistance in determining the cause and effects of migrations and other biological phenomena.

Table 28 - Commercial catch of sport fish in New England - 1952

Species	Pounds	Value
Bluefish	139,000	$ 27,747
Bonito	7,800	977
Cunner	6,900	201
Flounder	14,851,300	1,986,647
Fluke	6,860,700	1,308,431
Mackerel	12,525,100	954,660
Scup	6,807,400	391,860
Sea Bass	860,700	70,126
Shad	578,000	70,051
Smelt	177,900	41,721
Striped Bass	161,100	39,003
Swordfish	301,700	112,361
Tautog	130,200	6,412
Tuna	1,145,900	142,960
Weakfish	5,600	806
	44,559,300	$5,153,963

96. To date, there has been little or no research work done on any sport fish except the striped bass, tuna, weakfish, and shad. This work has been spasmodic thus far but in the case of the striped bass, at least, a well-organized, coordinated research program has been launched. This program was the result of the action by the Atlantic States Marine Fisheries Commission in setting up a striped bass committee. This committee sponsored the Cooperative Federal-State Striped Bass Research Program and all states in the range of the striped bass from Florida to Massachusetts have indicated that they would participate. The research work to be carried out by the states may ultimately result in an expenditure of $55,000 to $70,000 annually. As this program gets underway, it is possible that other sport fish species may be included.

97. Another problem that may become of importance in the future is the increase in numbers of anglers participating in the sport. Although most marine sport fishermen will travel considerable distances to the better fishing areas, the time will come, if it is not already here, when the demand to increase the local facilities will be made. In Connecticut, where the situation is becoming acute in some localities, the State Board of Fisheries and Game has recognized this problem and in its program of land acquisition will purchase coastal access points which will be developed for both car parking and boat launching. The cooperation of other public agencies owning coastal property will be sought to incorporate fishing facilities such as boat launching sites, suitable parking areas, capping of breakwaters, etc., on these properties. Massachusetts is considering a similar program. In Rhode Island, plans for the construction of two fishing piers, each 900 feet long, are being considered. This is not a problem of any magnitude at the present time, however, since at most boat yards and other facilities, expansion programs are underway or are being planned. The economic returns of these endeavors are considerable and most of the owners of sport fishing facilities are willing and able to make the necessary adjustments to keep up with the demand.

SUMMARY

98. A survey of the extent and value of the marine sport fishery in New England was made from July to October, 1954. Estimates as to the number of boats, anglers participating, value of tackle, and annual expenditures were gathered from about 150 persons. These people were

reportedly among the best informed regarding salt-water fishing in their localities.

99. The survey resulted in an estimated total of $68,423,155 invested in boats and tackle and an annual expenditure of $29,976,125 for all coastal New England States. An estimated total of 244,245 anglers participated in the sport.

100. The only major problem uncovered on the survey was the long-established conflict between the commercial and sport fishermen. The solution to the problem will require extensive research, education and cooperation of both groups.

101. Studies on the life histories of some important sport fish are underway and the provisions of the Saltonstall-Kennedy Bill will further aid in needed research.

102. The survey revealed that the marine sport fishery had increased tremendously since the end of World War II in regard to the numbers participating and the facilities available to anglers. The consensus of those primarily concerned with the sport was that they expected a still greater participation and that they would be able to handle the increase expected.

103. The economic data presented shows that the tremendous development of the New England marine sport fishery is making this activity an important economic factor in the region.

SECTION IV - WILDLIFE WETLANDS IN THE NEW ENGLAND-NEW YORK REGION

INTRODUCTION

1. A wildlife wetland is a unique biological habitat. Although the several types differ widely, all life peculiar to it depends on the fact that it is wet. Drain it and the habitat and its associated wildlife are destroyed.

2. Wetlands are the habitat of migratory waterfowl, which the United States is bound by international treaty to preserve, and fur animals, the basis of the valuable fur industry. In addition, coastal salt marshes are important as habitat for commercially important fish and shellfish. It is apparent that any loss of wetland habitat of value to these three groups is cause for concern.

3. The recent increased rate of destruction of wetlands by agricultural drainage throughout the United States has resulted in heavy losses of wildlife habitat, particularly in the vital waterfowl nesting regions of the Great Plains. In an effort to solve the problem, the Fish and Wildlife Service has embarked on a program to inventory the remaining wetlands of the United States in an effort to fit these areas, and the wildlife dependent on them, into all plans for utilization of lands and waters for economic purposes. Since waterfowl are particularly affected, the emphasis on the wetland survey is being given to this group of wildlife.

4. In the Nationwide wetlands program, the Fish and Wildlife Service has divided wetlands into 20 types. Major groupings are fresh, inland saline, coastal fresh and coastal saline areas. In addition

each wetland is evaluated according to its value to waterfowl and the acreages of the several wetland types in each area are determined.

SCOPE OF WETLAND SURVEYS

5. The formation of the several types of wetlands areas is controlled by the geology, topography, soils, climate, and other characteristics of the general area in which the wetland lies. The wetlands inventory, therefore, considered the physiographic regions and the use by waterfowl in arriving at the regions to be studied. In New England and New York the coastal wetlands, both on the Atlantic Ocean and on the Great Lakes, are of primary importance. Wetlands along the major rivers, such as the Hudson, St. Lawrence, and Connecticut were included. Inland, the marshes in the Finger Lakes area of New York, around Lake Champlain and the lakes of Maine are of vital importance to waterfowl. In addition to these inland wetlands, the inland bogs and marshes of Maine, in southeastern Massachusetts and in the lake plains area of New York are of material value to waterfowl. The areas described above were estimated to include the wetlands utilized by 90 percent of the waterfowl inhabiting the region. Lack of time prevented a survey of all inland regions in the New England-New York Region.

METHODS USED IN WETLAND INVENTORY

6. Excellent base maps were available for the wetlands inventory in the topographic maps of the U. S. Geological Survey, the Coast and Geodetic Survey and the Army Engineers. Since the survey was limited

Wetlands. Types 16 and 18, coastal salt marsh. Massachusetts. New England-New York Region.

to wetlands over 40 acres in size, all wetlands could be located readily on these maps. In some cases, the wetland type was depicted on the map. The majority of wetlands were classified as to type by inspecting U. S. Soil Conservation Service aerial photographs with a stereoscope and by checking areas of doubtful classification in the field. All of the coastal marshes were classified in the field since the stereoscope could not differentiate between the coastal marsh wetland types.

7. After the type and acreage data were obtained, the waterfowl biologists of the State Fish and Game Department evaluated the areas. The breakdown included high, moderate, low, and negligible values and referred only to waterfowl usage.

RESULTS

8. The data obtained on the wetlands survey in New England and New York showed that this region contained 15 of the 20 Nationwide wetland types. It has all of the inland fresh-water wetlands group, all of the coastal fresh-water group and three of the five coastal saline group. A description of these types and their values to waterfowl is given below.

a. Inland fresh areas.

Type 1 - Seasonally flooded basins or flats. Soil covered with water during variable seasonable periods. In the New England-New York Region this type is found mainly on the river bottoms. It is used by ducks for feeding when flooded. This type was not included in the inventory as such. It was included with other types, generally types 2, 3, 6, and 7.

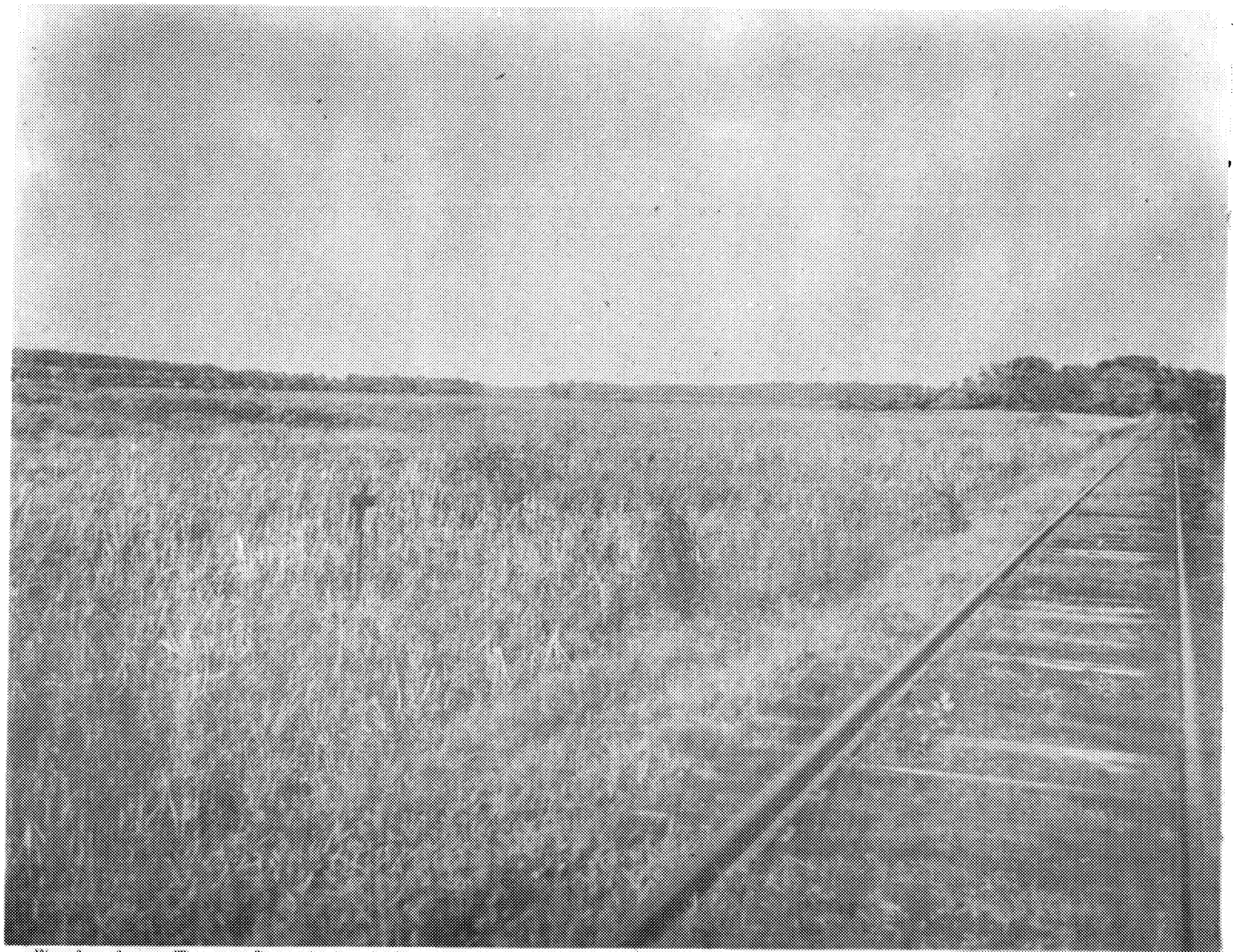
Type 2 - Fresh meadows. The soil of this type is waterlogged and contains such vegetation as sedges, rushes, grasses, and various broadleafed plants. It is used mostly as feeding grounds by waterfowl but, where favorable conditions occur, some nesting takes place.

Type 3 - Shallow fresh marshes. This type borders lakes, ponds, and deep marshes, or it may fill shallow, wet areas to a depth of six inches. The vegetation is composed of such species as cattails, bulrushes, and arrowheads. A very important type in the New England-New York Region, it is used for nesting and feeding.

Type 4 - Deep fresh marshes. This type is covered by from six inches to three feet of water and contains vegetation of cattails, reed, wildrice, and bulrushes. It is the most important inland type for waterfowl and is used for feeding, and in some cases, nesting.

Type 5 - Open fresh water. Inland water is of variable depth up to 10 feet in lakes, ponds, and reservoirs. Vegetation is of pondweeds, water lilies, coontail, and other aquatic forms. When fringed by marsh or when aquatic vegetation is plentiful, this type is of high value for waterfowl.

Type 6 - Shrub swamps. The soil in this type is usually waterlogged and it may be covered with as much as six inches of water. It contains such vegetation as alders, buttonbush, and dogwoods. This type is not too important as far as waterfowl are concerned, although wood and black ducks feed in it occasionally when it borders open water or contains shallow pools.



Wetlands. Types 3 and 4, inland freshwater marsh. New York, New England-New York Region.

Type 7 - Wooded swamps. The soil is waterlogged and often covered with as much as one foot of water. The vegetation consists of trees such as red or silver maple, elm, or cedar. This type is important to wood and black ducks for nesting and feeding when it borders open water.

Type 8 - Bogs. This type is fairly common in New York and Maine. The acid soil is usually waterlogged and contains both woody and herbaceous plants of the heath family as well as sedges and sphagnum moss. Like the wooded swamp, it is important to waterfowl only where it borders open water.

b. Coastal fresh areas.

Type 12 - Shallow fresh marshes is similar to Type 3 of the Inland series in physical characteristics, but borders coastal marshes where at high tide it is covered with as much as six inches of water. The Giant Reed, Phragmites communis, is common in this type. Other plant species are bulrush, threesquare, and cattail. Where the reed is not too dense, it is important as cover for migrating and nesting ducks and as feeding grounds.

Type 13 - Deep fresh marshes. The soil is covered at average high tide with as much as three feet of water. This type contains such vegetation as wildrice, bulrush, and pickerelweed. It is of high value as feeding and nesting grounds for ducks.

Type 14 - Open fresh water. The water is of variable depth located in tidal rivers and sounds. Vegetation of pondweeds, naiads and wild celery. It is an important type for waterfowl due to its food-producing ability.

c. Coastal saline areas

Type 15 - Salt flats. This type occurs in the New England-New York Region coastal saline marshes only as small basins, usually less than 50 feet in diameter. It is not common, and the total acreage is estimated at not more than 1,000 acres. Vegetation is sparse or patchy and is made up of such species as saltgrass, glasswort, and seablite. It is not of significant importance to waterfowl.

Type 16 - Salt meadows. Although the soil of this type is waterlogged, it is covered only by the storm or other higher-than-average tides. The vegetation is largely saltmeadow cordgrass with patches of saltgrass. In the fresher parts, threesquare and fleabanes occur. This type is of value to waterfowl if it contains ponds and potholes. Unfortunately, practically all of this type has been ditched for mosquito control.

Type 18 - Regularly flooded salt marshes. The soil of this type is covered at average high tide with as much as three feet of water. Vegetation is mainly saltmarsh cordgrass. It is used very much by feeding ducks and geese, particularly where ponds containing sago pondweed, horned pondweed, and widgeongrass are present.

Type 19 - Sounds and bays. This type contains open water of variable depths affected by tidal action. For the purposes of this inventory, this open water type is divided into two parts.

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Type 19 is defined as the area exposed at mean low tide; in other words, the mud flats or other bottom types which conceivably can be diked and filled. Type 19-P, not included in this inventory, is the open water seaward from the mean low tide line. The mud flats are of high value to black ducks and the shallow water areas over shellfish beds are utilized heavily by diving ducks.

9. The results of the wetland survey in each State are given in Tables 29 to 35. These tables show the value and acreage of each wetland type. The total wetland acreage classified during the inventory in New England and New York is 928,105 acres. Of this total, 278,084 acres are of high value, 167,973 are of moderate value, 299,001 are low in value, while 183,047 are graded negligible in value.

PRESENT AND FUTURE WETLANDS PROGRAMS

10. The foregoing was a presentation of the first phase of the wetlands program of the Fish and Wildlife Service. The second and third phases are not underway and will be continued.

11. The second phase is an inventory of the permanent water areas of significant value to waterfowl. Included here are the lakes, reservoirs, rivers, and ocean waters known to be used by waterfowl to the extent that these areas would be included in a State-wide waterfowl management program. This survey will determine the location and acreage of these permanent areas only.

12. The third phase is entitled the habitat preservation program. The completed wetlands inventory not only determined the quantitative and qualitative aspects of waterfowl habitat but also gathered data on the causes of wetlands destruction. Drainage of wetlands for agricultural purposes, so common in the Middle West, was of importance only in the lake plains area of New York. It was determined, however, that filling of wetlands for housing, industrial development, roads, and other purposes was of serious proportions in the coastal areas of Long Island and Connecticut. Ditching for mosquito control in coastal marshes was also an important destructive factor in that it drained the shallow pools which are high in value for waterfowl.

13. The third phase is designed to attempt to combat the unnecessary loss of valuable waterfowl habitat.

14. As a first step, all pertinent data on all wetlands evaluated as high or moderate will be gathered. This includes the noting of any activity which will tend to decrease the waterfowl value of the area. If any of these areas are found to be vulnerable, the data collected will be used to attempt to save the area for wildlife.

15. These programs have barely gotten underway and no progress can be reported. However, in view of the need for a coordinated waterfowl management plan, the wetlands program will be vigorously forwarded by both State and Federal agencies concerned with the problem.

Wetlands. Types 5, 6, 7 and 8, inland freshwater swamp and bog. Maine. New England-New York Region.

Table 29 - State summary
Wetland classification and evaluation
New England-New York Region

New York

Category	Type	High	Moderate	Low	Negligible	Total acreage by types
Inland fresh	2	2,400	750	1,615	305	5,070
	3	8,260	2,360	2,670	435	13,725
	4	10,370	3,325	195	10	13,900
	5	925	535	295	45	1,800
	6	3,975	2,850	4,880	355	12,060
	7	31,065	13,110	38,930	17,670	100,775
	8	1,000	10	40	1,180	2,230
Coastal fresh	12	2,680	2,075	1,210	1,080	7,045
	13	1,380	150	435		1,965
	14	115	30	20		165
Coastal saline	16	15,525	6,215	2,235	880	24,855
	18	7,225	2,465	1,600	240	11,530
	19	14,925	1,770	920	40	17,655
State totals		99,845	35,645	55,045	22,240	212,775

Table 30 - State summary
Wetland classification and evaluation
New England-New York Region

Maine

Category	Type	High	Moderate	Low	Negligible	Total acreage by types
Inland fresh	1	760	--	70	--	830
	2	120	1,490	1,480	1,805	4,895
	3	970	1,510	1,060	50	3,590
	4	1,770	1,195	800	5	3,770
	5	310	1,255	790	75	2,430
	6	130	3,725	9,660	3,725	17,840
	7	7,940	24,650	15,585	64,655	172,830
	8	7,730	17,760	43,270	9,975	78,735
Coastal fresh	12	2,100	620	--	--	2,720
	13	1,800	--	100	--	1,900
	14	3,100	--	105	--	3,205
Coastal saline	16	80	--	6,210	--	6,290
	18	200	30	1,225	--	1,455
	19	80,830	--	--	--	80,830
Totals		108,440	52,235	140,355	80,290	381,320

Table 31 - State summary
Wetland classification and evaluation
New England-New York Region

New Hampshire

Category	Type	High	Moderate	Low	Negligible	Total acreage by types
Inland fresh	2	110	--	--	--	110
	3	970	25	375	500	1,870
	4	50	--	--	--	50
	5	125	--	--	--	125
	7	130	50	--	--	180
	8	310	--	125	800	1,235
Coastal fresh	12	15	255	80	--	350
	13	--	50	--	--	50
Coastal saline	16	120	4,170	995	--	5,285
	18	15	265	95	--	375
	19	3,860	--	--	--	3,860
Totals		5,705	4,815	1,670	1,300	13,490

Table 32 - State summary
Wetland classification and evaluation
New England-New York Region

Vermont

Category	Type	High	Moderate	Low	Negligible	Total acreage by types
Inland fresh	2	--	300	163	1,290	1,753
	3	1,128	1,935	180	--	3,243
	4	2,926	485	10	--	3,421
	5	15	370	15	--	400
	6	460	3,690	490	--	4,640
	7	610	2,751	9,602	7,626	20,589
	8	1,532	--	2,495	--	4,027
Totals		6,671	9,531	12,955	8,916	38,073

Table 33 - State summary
Wetland classification and evaluation
New England-New York Region

Massachusetts

Category	Type	High	Moderate	Low	Negligible	Total acreage by types
Inland fresh	1	--	95	115	150	360
	2	1,345	4,325	3,620	1,550	10,840
	3	1,610	2,120	1,635	190	5,555
	4	1,315	500	375	260	2,450
	5	915	1,490	985	130	3,520
	6	3,720	8,505	10,175	5,430	27,830
	7	2,370	14,375	53,775	41,440	111,960
	8	20	160	55	10	245
Coastal fresh	12	925	515	865	--	2,305
	13	110	650	370	--	1,130
	14	170	--	5	--	175
Coastal saline	16	12,925	15,640	5,955	--	34,520
	18	2,760	2,885	2,295	--	7,940
	19	18,460	4,410	--	--	22,870
Totals		46,645	55,670	80,225	49,160	231,700

Table 34 - State summary
Wetland classification and evaluation
New England-New York Region

Connecticut

Category	Type	High	Moderate	Low	Negligible	Total acreage by types
Inland fresh	2	148	0	39	109	296
	3	275	250	33	96	654
	4	35	38	12	23	108
	6	259	175	122	70	626
	7	255	272	232	399	1,158
Coastal fresh	12	1,002	1,864	1,118	718	4,702
	13	991	437	241	71	1,740
	14	30	60	110	60	260
Coastal saline	16	1,368	2,875	2,096	1,157	7,496
	18	1,265	456	243	73	2,037
	19	1,270	1,585	515	950	4,320
Totals		6,898	8,012	4,761	3,726	23,397

Table 35 - State summary
Wetland classification and evaluation
New England-New York Region

Rhode Island

Category	Type	High	Moderate	Low	Negligible	Total acreage by types
Inland fresh	2	25	20	190	18	415
	3	190	160	360	190	900
	4	80	5	85	10	180
	5	1,035	20	75	70	1,200
	6	40	335	205	550	1,130
	7	--	95	1,685	16,370	18,150
	8	--	--	425	--	425
Coastal fresh	12	--	5	30	5	40
	13	--	130	--	25	155
	14	2,320	115	5	--	2,440
Coastal saline	16	--	710	635	15	1,360
	18	--	350	295	--	645
	19	190	120	--	--	310
Totals		3,880	2,065	3,990	17,415	27,350